

BOOK No. **1002**

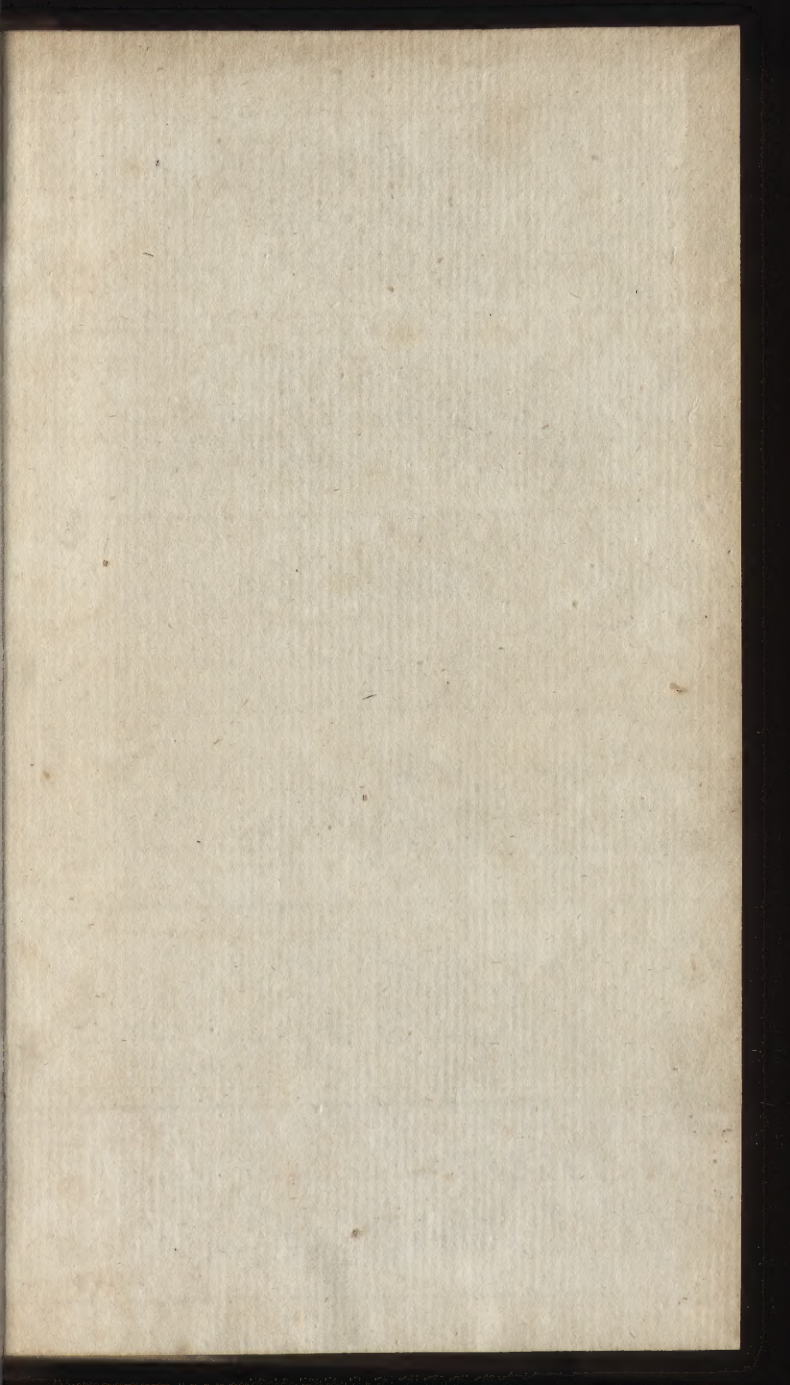
BAGGRAVE LIBRARY.

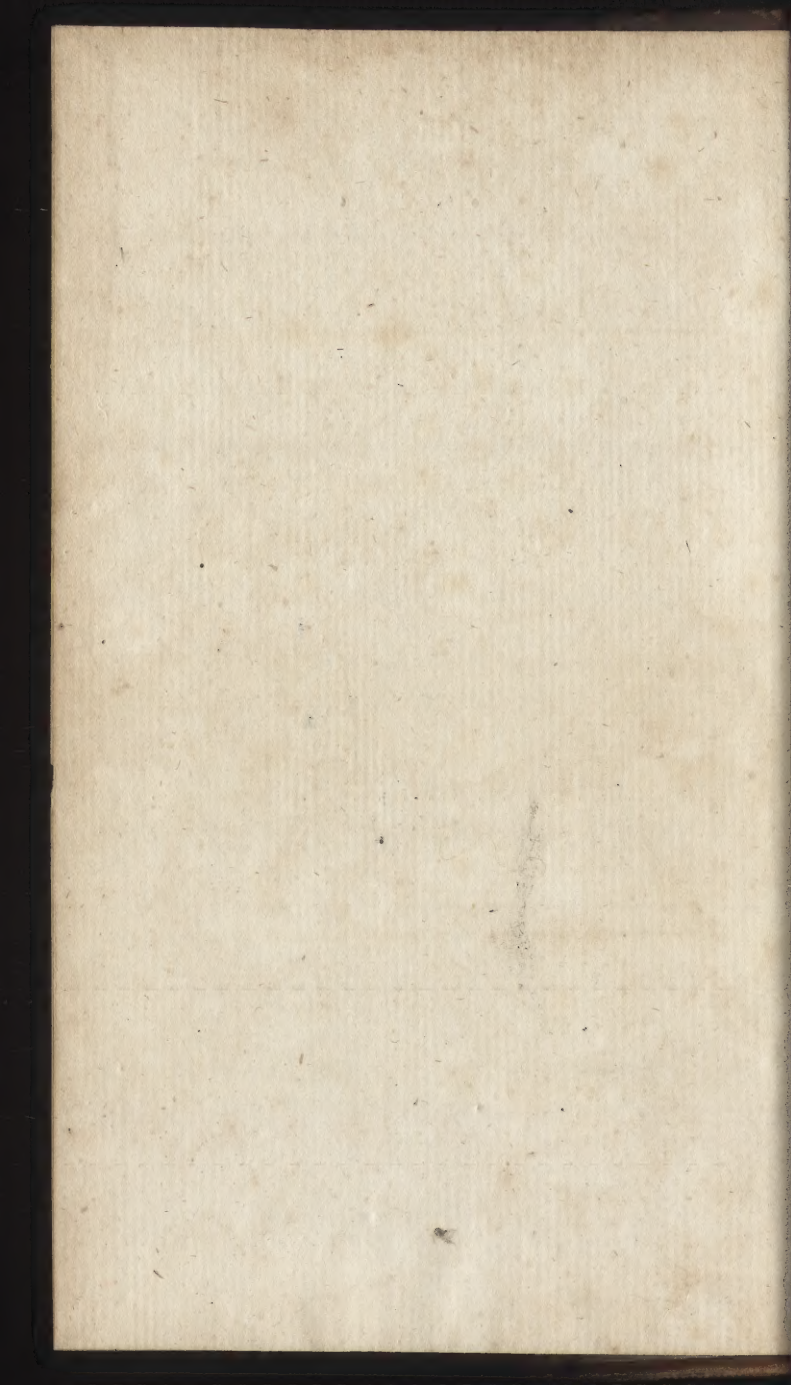
SHELF No. **52**

Ulrich Middeldorf

411

232C





JOURNAL

OF A

TOUR to ITALY.

JOHN A. B.

TOUR TO ITALY

JOURNAL

OF A

TOUR to ITALY.

CONTAINING,

(Among many other interesting and curious Particulars)

An Account of the Eruptions of Mount Vesuvius.	Parallel between the Horse-races at Rome and New-market.
Of the Curiosities discovered at Herculaneum	Description of Port Specia and the neighbouring Coast.
Of the leaning Towers of Pisa and Bologna.	Of the famous Emerald, or Holy Vessel, at Genoa.
Detection of the Impositions used in the pretended liquefying of the Blood of St. Januarius.	Remarks on the Mountains and Ice Valleys of Switzerland, &c. &c.

By M. de la CONDAMINE.

L O N D O N:

Printed for T. LEWIS, in Russel-street, Covent-Garden, and G. KEARSLEY, in Ludgate-street.

MDCCCLXIII.

JOHN

JOHN

JOHN

JOHN

JOHN

JOHN

JOHN

JOHN

T O

JAMES WEST, Esq;

Fellow of the Royal and Antiquarian
Societies, Honorary Trustee of the
British Museum, Representative in
Parliament for the Borough of St.
Albans, &c. &c.

S I R,

IF favours received are any
title to acknowledgements of
this sort, I know of no one who
has a better claim to them at my
hands. If a confessed fine taste
for the polite arts in general, with a

a 3

con-

consummate knowledge of the subjects here treated of in particular, are qualifications that constitute the requisites of a patron, I know of no one at whose hands I can more properly apply than at yours. In either case, therefore, Sir, this address will have a peculiar propriety. The first the world will readily allow me to be the best judge of. For the truth of the second I appeal to those illustrious societies of which you have long been so distinguished a member—to that noble collection of scarce and valuable
tracts

tracts in all languages and sciences, which take up no inconsiderable part of a very large mansion, and which it requires no vulgar hand to select—to those beautiful cabinets of medals in your possession, in which we see displayed such a regular series of the most important events of antiquity, and many of which are hardly to be met with in any other collection, either public or private, now in being—in short, Sir, to the testimony of all who have either had the happiness of knowing you, or have ever heard, with the least degree of precision, of your name.

It

It might be suspected, perhaps, that I am here running on according to the too general practice of dedicators, in extolling virtues which owe their existence to the imagination of the writer, who has at once created and magnified them for his own ends. But, Sir, there are two very powerful reasons, which I think must screen me from an imputation of this sort: the first, that I speak of well known facts; the second, that I fancy you will be at a very great loss to know whom of the many persons who lie under obligations to you, this present address comes from.

You

You must give me leave, Sir, likewise to add, that however sorry for it I may be, considered in a public light, it affords me a very singular pleasure as an individual, that I am able to address you, Sir, on this occasion, when the resignation of that honourable post, which you discharged for so many years with such signal credit to yourself, and such advantage to the publick, puts it out of your power to bestow the least gratification upon your friends, and consequently renders it the most improper time that I could have chosen.

chosen for a dedication founded upon interested views. For how readily soever I can resign all pretensions to fame as a writer, I should be sorry to have it thought that I have not a spirit above any thing that is mean or servile ; and as I have long known the indignity with which the ignorant, but more successful part of mankind, are apt to treat the whole race of authors, it would grieve me not a little to let drop any thing on this occasion, that could tend in the least to depreciate them in the eyes of the vulgar.

To

To conclude then, Sir; you are requested to accept of the following performance, as the humble offering of a grateful heart—as a work which, from the name of the author, and the nature of the subjects it treats upon, will probably be no disagreeable present to you—and as a very small token of that great respect with which I have the honour of being,

Sir,

Your obliged and

Very obedient

Feb. 21st
1763.

Humble Servant,

THE TRANSLATOR.



P R E F A C E.

THE name of M. de la Condamine is already so well known in the learned world, that it is almost unnecessary to say any thing here in favour of his abilities. While astronomical researches are thought worthy regard, his mensuration of a degree of the Equator will not be forgotten; and though the differences which arose between the gentlemen employed on that occasion;
ren-

rendered these mensurations in some measure imperfect, yet every one who is in the least conversant with the particulars of the voyage, knows that a very considerable share of the perfection they have is due to the indefatigableness, accuracy, and uncommon qualifications of M. de la Condamine.

Nor is it in astronomical researches alone that he has shown himself thus excellent, but almost in every other species of science. In the Journal now before us, we know not whether most to admire, the philosopher, the scholar,

lar,

lar, or the complete connoisseur; qualifications which, though seldom united in one person, yet all shine so eminently in him, that we are at a loss to say which he shines in most.

To this happy union of talents it is to be attributed, that in a road already worn so bare by frequent enquiries, he has been able to furnish us with so many new discoveries. For every thing to such a mind affords matter of observation; and if on any occasion he touches upon subjects that have been treated of before, his method of handling them is so

en-

entirely new, and his remarks so removed out of the common way, that we only wish he had touched upon such subjects oftener, as they would undoubtedly have furnished us with opportunities of oftener admiring him.

To instance only in the Lava of Vefuvius, what a noble field of philosophy has he opened to us there! a new system of worlds blazing forth upon us, and that not founded upon mere hypothesis and abstruse speculation, but upon facts which carry almost the force of demonstration along with them!

Nor are our gentlemen of the turf at all less obliged to him than the curious enquirers into the secret works of nature. Hitherto we have been taught to look upon the arts of the course in a contemptible light, but M. de la Condamine has shown them to be perfectly reducible to the graver rules of philosophy; from henceforward, therefore, we may expect to see sages themselves not disdain to appear at a horse-race, and our very squires and jockeys determining the velocity of those useful animals, not by make or size, but upon the most profound principles of the mathematicks.

We

We may expect to see the doctrine of *betting* rendered, at least, as easy as that of any other game of chance; and some future HOYLE, perhaps, arise, who from the force of the observations here laid down, and the aid of a few figures, shall teach our *sporting* gentry to judge as well for themselves in this kind of science, as his name-fake of immortal memory has done in the very profound games of whist and quadrille.

But, raillery apart, amidst the many useful as well as agreeable discoveries made by our Author,
it

it must afford every true Christian a very sensible pleasure to see that dangerous imposition of the church of Rome, which is every year so shamefully repeated in the pretended liquefaction of St. Januarius's blood, here so evidently overthrown and refuted. How a professed papist durst do this, I own is matter of surprize to me ; but that it was done by a papist, at the same time that it is a most convincing proof of his own candour, is one of the happiest circumstances in favour of that undisguised branch of the Christian religion which
we

we profess, that could possibly have happened.

To conclude: as no person seems better formed by nature to make those enquiries, which the imperfection of all human wisdom still leaves but too much room for, so nobody seems ever to have made them with more unre-mitted ardour and assiduity. Nor is his modesty, wherever he has occasion to mention himself, any ways inferior to his abilities. But candour, truth, and humility seem to have followed him wherever he went ; and to these
ami-

amiable qualities, no doubt, as well as to his uncommon share of learning, are to be attributed those great honours he met with from the eminent in every country through which he passed. There is but one thing that I know of in which the bulk of mankind have reason to be displeased with him; and this is, that when we see so many of them, particularly of our English gentry, taking much longer tours, from which nevertheless they return empty, though possessed of all the necessary means of improvement, M. de
la

la Condamine, who set out in an ill state of health, and unprovided of any such advantages, should furnish out at once such an agreeable and instructive narrative, as will for ever do honour to his memory.

ADVERTISEMENT.

AS two or three terms occur in the following Journal, which it is impossible to translate well into any other language, for the benefit of the mere English reader, we shall here endeavour to explain them as well as we can. Our more learned readers, for whom this explanation is not intended, will excuse us.

Facet, or *Facette* (the diminutive of face) signifies, in jewelry, the several little superficies into which a stone is cut. These are often, though improperly, called *squares*, being for the most part either *triangular* or *lozenges*.

Goutte de Suif, in English, *a tallow drop*, is used to express the surface of a chrystal, or other stone, cut in the rounding to the same degree as a drop of tallow on a plane.

En creux, or *in hollow*, in jewelry, silver work, &c. is the reverse of *embossed*, in sculpture, of *relief*. Thus in the former a coat of arms, &c. may be said to be cut *en creux*, when engraven in the stone; and so likewise of the latter, when
the

ADVERTISEMENT.

the figures are not raised above the surface. In moulding it signifies the *hollow* form of the plaster that has been laid on any *raised* piece of work, in order to take off the impression.

Relievo, or *relief*, the opposite of the foregoing, is applied in jewelry, sculpture, &c. to such figures as are raised above the surface of the work. Of this there are two kinds; the first called *bas* (or *low*) *relief*; the other, *haut* (or *high*) *relief*; which differ from each other only in their greater or less degree of prominency. The Italians distinguish them by the epithets of *basso* or *alto*, often to be met with in English writers.

Biseau, or *bizzel*, in precious stones, is when they are cut with a long plane, the length of the stone; or, if round, as in a picture or watch-glass, signifies a plane round the edge, terminating the rounded surface. Thus table-diamonds and other precious stones are said to be cut *en biseau*, when they have no *facettes* expressed on them. It sometimes also signifies the hollow rim or moulding of a socket made to receive a stone. In all other arts, where the chissel is used, it conveys pretty nearly the same image.

JOURNAL

JOURNAL

OF A

TOUR to ITALY.

IN a Tour, wherein the re-establishment of my health was at first my only object, unprovided of instruments, which I even avoided carrying with me, I was not able for the most part to make any other observations, than such as offered themselves to me of their own accord, and which it required only eyes to see.

B

I shall

I shall not seek, therefore, to excuse myself, if I bring not back a more ample harvest from such a country as Italy, where nature and art present a field so vast to the curiosity of a traveller. As for those master-pieces of sculpture, painting, and architecture, as well ancient as modern, which are to be found there, we have already descriptions of them by a masterly hand: Besides, it is my duty to confine myself in a memoir of this nature to matters which are more particularly the province of this academy. I shall preclude myself, therefore, as foreign to my object, from every detail relative to the fine arts and ancient monuments, at least unless physicks or the mathematics are particularly interested therein.

I set out from Paris on the 28th of December, 1754. The 7th of January

ary following, at the very instant that I was going to embark at Lyons, in order to fall down the Rhône, that river, being covered with ice, in spite of its rapidity ceased any longer to be navigable. A few days after, I saw carriages traversing that branch of it which bathes the walls of Avignon. I learned also that it was the same with the branch which separates the city of Arles from Languedoc, and that the surface of the other was entirely frozen over: An uncommon event, of which history furnishes very few examples.

It appears that the cold of the winter between the years 1754 and 1755, was severer in our southern provinces, than in the North of France. The liquor of two thermometers, divided into degrees according to the method of

B 2 M.

M. de Reaumur *, the one of spirits of wine, the other of mercury, being exposed to the air, fell at Lyons, on the 17th of February, to between sixteen and seventeen degrees below the point of freezing ; which is about two divisions lower than the same instrument fell at Paris during the celebrated winter of 1709. Another thermometer of the same construction, in a closet exposed to the South, descended at Arles to the twenty-second degree ; while at Marseilles, in a latitude somewhat more northern, but in a situation more sheltered from the North winds, a like thermometer scarce attained to $4\frac{2}{3}$ degrees beneath the point of freezing,

* In the observatory of Father Beraud, a Jesuit, professor of mathematicks in the great college at Lyons, and correspondent of the Academy of Sciences.

and that only once in the same winter; that is to say, on the 7th of January in the morning, before the rising of the sun *. The same day, instruments of the like construction marked seven degrees at Montpellier, and eight at Nîmes.

In the memory of man they had never seen before at Montpellier two feet depth of snow. All the neighbouring fields, as far as the sight could extend, were still so covered with it in the beginning of February, that it reached in several places up to the middle of the wheels of my chaise. Languedoc and Provence presented me with an aspect of the summit of the

* The latitude of Montpellier is about $43^{\text{d}} 36' \frac{1}{2}$; that of Arles $43^{\text{d}} 40' \frac{1}{2}$; that of Marseilles $43^{\text{d}} 18'$.

Cordilleras of Peru. The verdure of the hedges and olive-trees, which even winter strips not there of its leaves, had now entirely disappeared beneath the snow : No other object met my eyes. A Laplander would not have believed himself out of his own country.

The Pont du Gard, the ancient temple vulgarly called the Square-House, the Amphitheatre, all those beautiful remains of antiquity at Nîmes and its environs, comparable even to the most remarkable of the kind that Italy itself presents, enter not, as I have already said, into the plan of this memoir : But can a traveller who takes up the pen, at least unless he be blind, or a misanthrope, pass over in silence the beauty, the convenience of our highways, now become perfect walks ? An advantage of such importance to a state,

state, and which so many people enjoy without knowing the value of it; an advantage reserved for our age, our country, and the present administration; an advantage so envied France as happily to excite the emulation of all her neighbours: The many labours of this kind which I have seen in Piemont, Tuscany, and the Ecclesiastical State, are witnesses hereof; but these last approach by no means in goodness, if we may believe common fame, to those admired ones on the new road from Trieste to Vienna, opened through the very middle of the mountains of Istria and Friouli, under the auspices of the empress-queen, with a magnificence worthy the ancient Romans.

Why do we still hesitate to adorn the sides of all our high roads with boundaries placed at equal distances?

B 4 an

an ancient custom, of which we cannot sufficiently extol the agreeableness and utility ; a custom established among divers of the modern nations in the East, and which it is astonishing that all Europe has not yet adopted. This custom has just introduced itself into the papal territories by the orders of the reigning pontiff * : An inscription to be read on a bridge as we draw near to Rimini, points out, with an elegant and Laconic simplicity, the design of these boundaries : *Viatorum solatio & commoditati* : For the consolation and convenience of travellers.

The ancients contented themselves with marking on their stones the number of miles, to be counted from the

* Benedict XIV. who died in 1758.

Capitol *. They have improved on this custom in the new boundaries placed along the high roads of Languedoc, by order of the states of that province, and under the direction of M. Pitot of this academy. These boundaries are square,

* The method observed in this respect by the Romans admits of some debate. Tacitus informs us, that they computed their miles from a golden pillar (χρυσὴν μίλιον, though, by the way, it is said to have been only of white marble, about eight feet high, with a gilt ball at top, from whence it is supposed to have obtained the epithet of golden) erected by Augustus near the temple of Saturn, at Rome. From this column, stones were placed at equal distances throughout all the high roads of Italy. Now the question among the learned is, whether the numbers, II, III, &c. marked on these stones, denoted as many miles from the city, or only the second and third stone from the above-mentioned pillar, whereon was engraven figure I. This last opinion has the greatest number of followers. *Thomas's Eutropius.*

four feet above the earth, and have one of their angles turned towards the road, in such a manner, that a passenger discovers at once the two faces of this salient angle. On the one, he reads how many thousand toises he has travelled since the morning, and on the other how many thousand toises remain to be completed before night. The sum of these two numbers shews the distance of the two places, which are the ordinary days journey of the traveller.

Another example of the ancients, respecting their highways, would perhaps be worthy of imitation. I have observed in those remains of their roads which are yet subsisting, that the joints of the large stones wherewith they are paved, are never placed in the same direction with the highway; a circumstance by which it comes to pass, that
the

the wheels of carriages meeting with the joints in no other position than obliquely, tend of course less to disunite the stones *.

At my return from Montpellier to Avignon, where I made a second stay, I found there her Royal Highness the Margravine of Bareith, sister to the king of Prussia, who passed the winter in that city. I admired in this princess those marks of knowledge and talents

* A tryal of this has been made in the environs of Paris; but there some inconveniences were found to arise from it, proceeding perhaps from the smallness of the stones with which our high-roads are paved, they being only eight inches square; but principally from the increase of labour, which the necessity of ramming down the saliant angles of these pavements demands, in order to render the two sides of the causey even.

so very uncommon in persons of her sex and rank. I saw in the hands of one of her ladies of honour a watch-case, cut facet-wise, which resembled polished steel; on examination, I perceived that the matter whereof it was made, was not unlike that species of mineral stone, of which great numbers are found in the ancient sepulchres in Peru. They are plane and smooth on one side, convex and conick on the other, and known in that country under the name of the *Inca's Looking-glasses*. It is a sort of pyrite which strikes fire with steel. This matter has nothing metallic in it, though it has all the appearances thereof. It receives the finest polish, and is not susceptible of rust; which made me imagine it might be proper for making glasses for reflecting telescopes: but though I brought back several pieces of it, cut at Quito,

some

some *en gouttes de Suif*, others brilliant, fit for making buckles or buttons, I never could find at Paris any workmen who knew how to polish the rough fragments well, which I put in their hands. It has besides a yellowish tint, which would infallibly alter the colour of objects. Germany has mines of this matter; and I learned that the watch-case which I saw before my eyes, had been cut at Bareith, where they find also several species of coloured flints; and among others, a yellow one on a grey ground, of which they make beautiful cameos. With respect to the watch-case made of pyrite, the matter of it appeared to me much less beautiful, and of a less lively polish, than those pieces which I brought from Quito.

I afterwards rejoined, in my several excursions in Italy, the margravine, and
the

the prince her spouse. The presents with which they honoured me, and those distributed by them in the places where they made any stay, have frequently furnished me with an opportunity of observing the skill of the German workmen in an art too much neglected by us, that of cutting *en creux*, as well as in relief, flints, agates, jaspers, porphyries, lapis lazuli, cornelians, emeralds and amethysts; and of representing, by incrusting these stones one upon another, flowers and animals in relief, with their natural colours.

The great quantity of marble employed in their edifices was the first thing which struck me in Italy. Temples and palaces, cased with white marble, are very common at Genoa.

In

In the treasury belonging to the cathedral of that city is preserved, with the greatest veneration, for upwards of six hundred years, a dish, or rather an hexagon bowl, which they pretend to be made of emerald. It has two small handles, and consists of one single piece: its greatest diameter is about fourteen inches and a half; its height, five inches nine lines; its thickness, three lines. This monument is kept under several keys, deposited in different hands. When it is shown, which happens but seldom, and by virtue only of a decree of the senate, the vessel is let down by a cord, passed through its two handles, and suspended around the priest's neck, who presides at the exhibition; but never goes out of his hands. By an ancient decree of the senate, bearing date 24th of May 1476, it is forbid, under severe penalties, to approach too near this sacred

cred vessel (*il sacro catino*), and much more to touch it with any metal whatsoever. All this apparatus and these difficulties seem only so many precautions taken against those who might want to satisfy themselves by some proof, such as that of the file, or graving-tool, whether the matter of which this vessel is composed, be really of the hardness of an emerald.

Nevertheless they produce an act, by which it appears that the vessel was pledged by deliberation of the senate, in 1319, during the siege of Genoa, to cardinal Luke de Fiesqui, for a sum equivalent to twelve hundred marks of gold, and that this sum was paid off and the pledge withdrawn twelve years after. This seems to prove, that the great value of the matter of this deposit was at that time without suspicion.

I see

I see not what presumption in favour of the matter of this vessel can be drawn from the circumstance of one of its handles being cracked ; nor how this proof, which is supposed to have been made in the presence of the emperor Charles V. could ascertain the genuineness of the emerald.

The princes Corfini, grand nephews to pope Clement XII. whom I had the honour of accompanying from Marseilles to Genoa, having obtained from the senate the necessary decree to see this monument, I availed myself of the opportunity in order to examine it. I viewed it attentively, opposing it to the light of a large taper. The colour appeared to me of a very deep green : I perceived not in it the least trace of those icicles, straws, clouds, and other defects of transparency so common in emeralds
and

and all other precious stones of the least thickness, even in rock chrystal; but I distinguished very evidently several little voids, resembling small bubbles of air, of a round or oblong form, such as are commonly found in chrystals, or glass, whether white or coloured.

One would not expect that a prejudice of the twelfth century should be blindly respected in the eighteenth; nevertheless I know not that any modern traveller has combated it; and the Geographical Dictionary of Martinere, edition 1740, says positively, "that they preserve at Genoa a precious vessel of inestimable value," which assertion I am the more astonished at, as my doubt is by no means new. It is clearly indicated in the expressions employed by William archbishop of Tyre, about four centuries ago, where he says, that at the
taking

taking of “ Cæsarea this vessel fell by
 “ lot, for a large sum of money, to the
 “ Genoese, who believed it to be an eme-
 “ rald, and who show it still as such, and
 “ as something wonderful, to strangers.*”
 For the rest, it belongs only to those
 whom these suspicions may displease, to
 destroy them, if they are not well found-
 ed; and I have not entered into this
 detail, but in the hope that a fact, the
 clearing up of which is so easy, will not
 remain any longer in obscurity; or that
 this obscurity, if it should continue, will
 change these suspicions into certainty.

I drew the figure and dimensions of
 the vessel of Genoa, such as I now lay

* *Januenses Smaragdinum reputantes, pro
 multâ pecuniæ summâ in sortem recipientes us-
 que hodie transeuntibus. . . . Vas idem quasi pro mi-
 raculo solent ostendere, &c.* Guill. Tyr. Archiepisc.
 Lib. X. Cap. XVI.

them before this assembly, from a work published at Genoa in 1726, by a religious of the Augustine order, and filled with historical researches on this subject. The author leaves undecided the question which he proposes to himself, whether this precious moveable was brought by the Genoese from the siege of Cæsarea in Palestine, in the year 1101 (as appears evident by the testimony of William of Tyre) or from the siege of Almeria, taken by the Moors in 1147; but he discusses with great erudition through what hands the vessel has passed, since the queen of Sheba made a present of it to Solomon, to the time wherein it was employed to serve up the paschal lamb to our Saviour on the eve of his passion: this is a point on which our author has not the least doubt. As for what respects the matter of it, he maintains that it is certainly an emerald; and his
strongest

strongest argument is, that the matter of a vessel which served for the supper wherein our Lord instituted the august sacrament of the Eucharist, could not be too precious. This principle once admitted, would lead the author farther than he desires, and prove that the dish ought to be a diamond.

I saw at Rome, in the hands of M. Assemani, prelate of the Maronites, and keeper of the Vatican library, two transparent stones, of a very beautiful green colour. I learned from him that he had brought them from Egypt, and that they were taken out of a large block which he saw entire. The largest of those pieces is about six inches long, by three and a quarter broad, and two or two and a half thick. They are looked upon as emeralds. This I can certify, that they have the hardness of one: The
graving

graving tool which I applied to them left no marks behind: they are besides of a great clearness: the colour is by much less deep, though on a greater thickness, than that of the dish of Genoa: the transparency of it is every where equal: in short I observed not in it the least defect; a circumstance, it is true, very rare in emeralds, even of a lesser bulk; but what is still more, I perceived not in it the least bubble of air, a defect so common in cast glass. These two pieces are nothing in comparison of a stone of the same colour, weighing upwards of twenty pounds, and of a quadrangular form, which is kept in the convent of Reichenau, near Constance, being a present of Charlemagne's to that abby. It is pretended that the Monks made a considerable sum of the fragments alone, but were not able to obtain the permission of the emperor Charles VI. to sell the
the

the rest. I have never seen this stone; but its figure, and the dimensions of the block, are to be found in Keyßler's German Travels, printed at Hanover in 1740 †.

We know not now-a-days of any other emeralds than those which are drawn from America, or the new kingdom of Grenada. Historians relate, that at the time of the discovery of the new world, the Spaniards found great numbers of them at Puerto Viejo, and Manta, on the coast of Peru, in the province of Quito. It is pretty singular, that even the tradition of this should

† The emerald our author here alludes to is in size larger than a common folio, two inches thick, and weighs twenty-eight pounds three quarters. See Busching's Geography, English translation, vol. 5th. page 165.

now be lost ; but that I can assert for a truth, after strict enquiries which I made in the country. The River of Emeralds, which I travelled up to its source, the Indian hamlet situated near the mouth of it, the little mountain, in fine, the very province of which the late Don Pedro Maldonado, my companion in the voyage up the river Amazons, was governor, all these places bear still the name of Esmeraldas, but preserve only the name. Not the least vestige is to be seen there of the ancient works; and if there ever have been any, the memory of them is entirely lost among the natives of the country.

We are as little instructed in the natural history of the emerald, and in the difference of the occidental and oriental ones, whose very existence Tavernier denies. We know as little of the places
from

from whence the ancients drew theirs. What we read in Herodotus and Pliny, of the prodigious bigness of some of them, appears so remote from any likelihood of truth, that it were to be wished, at least that what concerns the largest and most celebrated emeralds now in Europe, were well known and thoroughly settled.

Almost all the rocks on the coast of the state of Genoa, are of ardoise or marble. A little beyond these we find at about a league's distance from the sea, in the principality of Massa, the small city of Carrara, a new Paros, from whence they draw a beautiful marble, which we name Carrara, the whitest and most proper of any for sculpture.

In passing from Genoa to Lerici on board a felucca, I entered the gulf of
C Specia,

Specia, where I saw a spring of fresh water in the midst of the sea. This gulf, on the borders of which are seen the ruins of the ancient city of Luna, destroyed by the Saracens, forms the most beautiful and largest port of the Mediterranean, and perhaps of the whole world. It is of this port that Silius Italicus said,

——— *Quo non spatiosior alter*
Innumeras cepisse rates, & claudere
pontum. Lib. viii. V. 481.

It comprehends within its sweep, and in its bays, several other ports: two naval armaments may lie there at anchor, without seeing each other.

The port of Leghorn, its advantageous situation for commerce, and the protection of the great dukes of Medicis, have

have raised, in less than two centuries, from a hamlet to a flourishing city, and peopled with 40,000 inhabitants; tho' situated on a coast desert, marshy, and unhealthy, as the greatest part of the maritime towns of Tuscany and the Ecclesiastical State are. This example proves, that with care, expence, and a settled system of government (conditions difficult to assemble together) the most unhealthy countries may become habitable, cultivated, and fertile.

The excavations which publick works bring along with them, are almost always the occasion of some new discovery in the fossil kind. The labours created by the port of Leghorn greatly enriched the celebrated cabinet of the chevalier de Baillon, which the emperor has purchased, and which that

C 2 prince

prince caused to be transported from Florence to Vienna a few years ago.

His imperial majesty sends into all parts of the world naturalists and draughtsmen in order to gather new harvests. In my way to Marseilles, I received a visit from a young Dutch physician, who was on the point of embarking with two assistants for Spanish America: He was charged to make collections there of every kind for the emperor's cabinet at Vienna.

His imperial majesty's taste for natural history is so strong, is seconded with so much zeal by his subjects, that his cabinet, formed in a few years, bears the palm at present, in the mineralogic part, according to the testimony of a very intelligent and indisputable witness,

ness, from the two most celebrated cabinets in Europe taken together; to wit, that of his most Christian majesty, and the British cabinet purchased of the heirs of Sir Hans Sloane by the government of England. A powerful prince has but to desire, natural difficulties smoothen themselves before him, and moral impossibilities disappear.

Tuscany abounds in minerals and in fossils of every kind; cabinets of natural history are more common there than in other parts of Italy. The marquis Ginori, governor of Leghorn, has pursued his enquiries for several years past, with considerable labour, into the earths, stones, minerals, and all the fossils of the country. He has shown me his tables, containing the result of his several experiments on matter vitriifiable and calcinable, pure and mixed

in different proportions, subjected to the fire, or submitted to the action of various dissolvents. In the manufactory of Porcelaine, established at his expense at Florence, pieces are made of very considerable bigness. I have seen there statues and groupes half as large as the life, modelled after the most beautiful antiques. His furnaces are made with a great deal of art, and cased with bricks of the same materials with the porcelaine. The clay of this is very beautiful; and one might perceive in the grain of the broken pieces all the qualities of the best porcelaine from China. They wish indeed to that of Florence a whiter varnish for the ground; and this perfection would not probably be wanting to it, if the marquis Ginori had not made it a law with himself, to employ no other materials.

materials than those which he draws out of the very country *.

I saw, in a cabinet at Leghorn, a piece of the jaw-bone of an elephant, petrified into agate, and weighing near twenty pounds. I have spoken elsewhere of a grinder (it was not known of what animal) weighing between two and three pounds, in like manner converted into agate, and found at Tucuman, in North America, where there are no elephants. It made part of a considerable cargo, the loss of which I have already deplored, consisting of a pretty large number of scarce pieces, destined for the king's cabinet, which

* The marquis Ginori is dead since the reading of this memoir; and I know not into what hands his papers and the tables containing the result of his experiments are fallen.

I addressed to the academy by way of the late M. de Fay, and embarked at Callao, the port of Lima, on board a vessel which sailed for Panama on the 2d of May 1737 *.

At another person's in Leghorn I saw three small animals, which they call in Italy *Taupes de Carthage*. They are like squirrels: Their two fore-paws are very short, and serve them instead of hands; they go only by leaping on their hind-feet. It appears that Aristotle and Theophrastus knew this animal; we find a very minute description of them in the Tuscany magazine of 1755, a periodical work, which appeared monthly, under the direction of

* See the historical journal of a voyage to the Equator, published at the Louvre in 1750, note, page 104.

the Abbé Venuti, provost of the church of Leghorn, and associated-stranger of the academy of Belles-Lettres at Paris, who desired that I would lodge with him during my abode at Leghorn.

I arrived at Pisa on the very night of the eclipse of the moon of the 27th of March 1755. M. Perelli, professor of astronomy in the university of that city, communicated to me the phases which he had observed, and some other remarks; such as the latitude of the observatory of Pisa, which in 1753 was $43^{\text{d}} 43' 1''$, and the obliquity of the ecliptick, which was $23^{\text{d}} 28' 19''$.

Pisa has lost much of its ancient splendor: We still see there, nevertheless, temples, towers, and a very beautiful bridge of white marble, not to mention the columns and other monuments

of antiquity brought thither from Greece. The cathedral, an immense building, is cased with the same marble. There is no other material in a chapel called St. Epina's (or the Holy Thorn) built alone out of the savings of a beggar. The round tower, near the cathedral, is of the most beautiful marble of Carrara. This tower, which is ornamented with seven rows of pillars, without counting that of the turret, was built near six hundred years ago. It is about four toises in diameter, and is particularly famous for its inclination, which makes it look at first sight as if it threatened ruin. Some have pretended, that it was built out of design with this apparent defect. This ridiculous conjecture, adopted by Martinier's dictionary, is confuted by the slightest attention. All the lintels of the doors are shattered; the bearings of
the

the stone are not horizontal ; the greatest part of all the ancient towers in Pifa incline in the like direction ; several of the uprights and spurs of the cathedral lean the same way ; which proves that the ground-plat of these edifices being built before the use of foundations upon piles, it has verged towards the South, which is on the side towards the river.

An evident proof that the ground of Pifa is not solid is, that the observatory of that city, a very beautiful building, erected about ten years ago, on the foundations of an ancient tower, sunk in the month of March 1755 upwards of a Paris foot. This is what M. Perelli, then director of that observatory, assured himself of.

I measured with a line and plummet the height and inclination of the tower of Pisa : The defect of its level is about thirteen feet, Paris measure, counting from the foot of the balustrade placed on the platform, to the foot of the cupola or little turret on top, in which are the bells. I found the height of the said platform above the level of the place, or superficies of the ground on which the cathedral stood, to be a hundred and thirty-three feet ; to which adding about twenty-seven feet more for the height of the turret (which leans more than the body of the tower), eight feet for the depth of the trench, and about two feet, which the line measured since the operation, uncharged with any weight, would have appeared shorter ; we shall have for the total height of the tower a hundred and seventy feet, on the
side

side where it inclines most; infomuch, that were it set upright again, it would be within a very little of a hundred and seventy-two feet high *. This height

* A remarkable curiosity of this kind, though, like most other English curiosities, little known or regarded, is to be seen in Caerphilly-castle in Glamorganshire, in South Wales. Amidst the many other tremendous pieces which compose that vast pile of ruins, is a large tower, nearly towards the East end, which every moment threatens destruction to the unwary passenger. Its height is not by a great deal so much as that of Pisa, being not above seventy or eighty feet, at most; but from the top down almost to the middle runs a large fissure, by which the tower is divided into two separate parts, so that each side hangs over its base, in such a manner that it is difficult to say which is most likely to fall first. According to the opinion of the ingenious Mr. Wood of Bath, who lay upon his back for several minutes to view this dreadful ruin, its lineal projection, on the outer side, is not less than ten feet

height is not the half of that of the tower of Asinelli at Bologna. The latter is only of brick; its form square; but its base appears much straighter than that of the tower of Pisa. They give to the tower of Asinelli three hundred and seventy-one Rhinland feet, which make near three hundred and fifty-eight of ours. The towers of the church of Notre Dame at Paris are no more than two hundred and four. Another tower at Bologna, called the *Garisenda*, of the same materials, the same form, and the same diameter, seemingly, as the tower of Asinelli, appears to the eye to lean no less than

feet and a half. What renders it still the more remarkable is, that it has continued to project in this manner for many ages past; nor have we the least account given us, either from history or tradition, how it first happened.

the

the tower of Pifa; but the upper part of the Garisenda is tumbled down, or has been demolished, in order to prevent its fall.

It is on the bridge of marble, which I have spoken of above, that they exhibit at Pifa every three years a singular festival, of which I was a witness. Its origin is lost in the remoteness of antiquity *. Six hundred and forty champions, divided into two troops, armed with cuirasses and gilt helmets, dispute with each other the bridge with heavy blows of clubs; frequently they hurl one another into the river, where there are boats ready to receive and succour them: The carnage of the combatants

* See the Book entitled *Oplomachia Pisana*, published in quarto, at Lucca, in 1713.

sometimes renders this spectacle tragical. It could only furnish me with chirurgical observations, which I have not made a part of my collection.

I returned from Pisa to Florence, where every thing invites a passenger to prolong his stay; and where, overwhelmed with the marks of attention and favours of the Corsini family, I occupied the largest and most beautiful palace of the city, in the absence of its masters, who, ever since the pontificate of Clement XII. make their ordinary residence at Rome.

On transporting to Vienna the cabinet of natural history purchased by the emperor at Florence, that prince left in this city a prodigious number of vases, jewels, and works of art, both ancient and modern, composed of the most
valuable

valuable materials and set in the richest workmanship, which made and still make a part of the immense collection of antiquities and curiosities of the gallery of the palace of Medicis, where this kind of curiosities alone takes up several very large armories. A description of this gallery has been long promised to the publick. The chapel of St. Laurence, destined for the sepulture of the princes of the house of Medicis, into which the most precious marbles are scarce admitted, includes within its shell, which is not yet finished, the richest and most magnificent assemblage of large pieces of jasper, porphyry, lapis luzuli, &c. which are seen only in small solitary fragments in the richest cabinets of Europe.

We know, that it is with small
prisms or cubes of these hard
stones,

stones, artificially fixed in a cement prepared for the purpose, that the ancients delineated ornaments of flowers, animals, and even human figures, in colours that are unalterable, which they called *Opus tessellatum*, or *Musivum*, and we *Mosaick* *. One of the most beautiful monuments in this kind, among those which are not already published, is a pavement above ground, found at Frascati, in a house belonging to the Jesuits, called *Rufinella*, which, it is pretended, made a part of Cicero's *Tusculum*. We see there a bust of Minerva, armed with a casque and cuirass, much larger than nature, and executed in the grandest manner. Chymistry, in giving to glass colours no

* See the treatise of M. now Cardinal, Furietti, concerning Mosaicks, published at Rome in quarto, 1752.

less durable, oftentimes more lively than those of the hard stones, together with all sorts of shades, has put the artists of the middle age in a condition to bring this beautiful art to perfection *. It is at Rome that it is cultivated with the greatest success, especially for upwards of a century past; owing to the immense number of works carried on in the church of St. Peter. All the vaults of it are, or will very

* In many of the old Mosaicks, we sometimes find, especially on the borders, pieces of coloured glass; but if we may suppose that this is a reparation, less ancient than the work, we may at least remark that these pieces have not all the shades in them which the modern Mosaicks have, and that they only form therein compartments of glaring colours. The materials of the antique Mosaicks, which represent human figures, or other animals, are of marble, brick, or clouded flints, of various colours.

shortly

shortly be, covered with performances of this kind; the several tables of the altars in the chapels will be executed in the same manner: It is thus that they have found out the means of rendering a portrait as durable as a statue, and of eternising those masterpieces of painting, which two or three ages would have sufficed to destroy.

They have endeavoured to improve upon the mosaick of the hard stones, by substituting in its stead a species of pinked or inlaid work of the same materials. This inlaid work is not composed of small prismatical or cubical pieces, proportioned to each other, such as are made use of in the common mosaick; the new incrustation is formed of large unequal pieces, cut as the contour of the objects to be represented requires. At first they confined it
to

to the representation of flowers and fruits in their natural colours, sometimes of birds and insects, delineated by proportionate pieces of agate, jasper, lapis luzuli, cornelian, and coloured flints. We have in France, in some of the royal houses, and in some great noblemens seats, beautiful pictures made in this manner in the last century: but in the modern works at Florence, Rome, and Naples, they have attempted to introduce human figures.

This kind of work has two advantages over the mosaick. They save hereby that great number of joints and angles which are unavoidable in the assemblage of small prisms, of which mosaick is composed; but what they gain thereby in the correctness of the design, which the piece traced out follows exactly in the contours, and in the beauty of the colours, which is
not

not tarnished by the joints, they lose in the degradation of the tints, which the variety of shades in the small cubes of the mosaick renders much superior to those in the large pieces. In the more recent pictures, where they have introduced human figures, this difference is yet more perceptible. A stone cut on the very contour of the figure, gives a neater draught, and the design, viewed near at hand, is more exact; but the fleshy parts, and the draperies formed by the large pieces expressive of them, have no demi-tints, and resemble rather inlaid works that are coloured: The pictures of this kind, even of pure architecture, though seducing at the first glance of the eye, are not exempt from this defect.

The meridian of St. Petrona's, traced at Bologna above a century ago, by the illustrious Dominick Cassini, is well

well known throughout all Europe: but it is in general very little known, that the greatest of all the monuments in this kind, has existed for upwards of these three centuries past in the cathedral church of Florence, and that Paul Toscanelli was the author of it.

During my abode in that city, I examined with father Ximenes the jesuit*, professor of mathematicks, and now geographer to his imperial majesty, the several parts of this ancient meridian, at that time buried in the most profound oblivion†. The great solidity of the brass plate, destined to serve as a centre to the dial pin, which is seven lines thick, enchased and sealed in the cornice of the lantern, which crowns the

* This memoir was read in 1757.

† See page 41, of the historical introduction to the work, cited in the following note.

dome, and supported by two strong brackets also of brass, pierced with the most careful attention by a conical opening *en biseau*; the projecting part of the stone (in which this plate is fixed) being beaten down, and the border of it made hollow, that the whole plate might be always illuminated by the sun at noon; its height of upwards of two hundred and seventy seven feet, Paris measure, above the pavement of the church; the diameter of the hole, which is less than the two thousandth part of its height; the circular marble fixed in the pavement of the church, in order to receive the projection of the sun's shadow in the summer solstice; the observation made on this marble in 1510, attested by an inscription which is still legible: all these circumstances denote the capacity and great views of the author of this work. I regretted that so beautiful a monument
of

of modern astronomy, raised in an age when the arts and sciences had not yet triumphed over barbarism, should continue in obscurity, and that it should remain without use in an age so enlightened as ours. I made thereupon some representations to the count de Richecourt, president of the council of regency of Tuscany. He seemed to me to pay great attention to them. In short, I learned some little time after, at Rome, that his imperial majesty, being informed by that minister of the importance and utility of the meridian in the cathedral of Florence, to the progress of astronomy, had signified it as his pleasure that nothing should be wanting to its restoration. Father Ximenes, being charged with the execution of the emperor's orders, has since rectified with a scrupulous exactness all the parts of the ancient dial; has retraced and repaired the meridional

D line,

line, has re-established its level, has made new solstitial observations, and has concluded, in short, by a comparison of them with the ancient ones, that the obliquity of the ecliptick was less by a minute and sixteen seconds in 1755, than in 1510. He gives an account of all his labours in a work in 4to, which is now beneath the press*. In 1756, I received at Rome a manuscript sheet from him, containing his first observations, which he requested me to communicate to the academy: I fulfilled his desire, and the academy have admitted him into the number of their correspondents.

* This work has appeared since the reading of this memoir, under the title of *Vecchio e nuove Gnomone Fiorentino*, Florence, 1757. i. e. The old and new dial of Florence, published in that city in 1757.

All the dimensions of the new meridian were taken in toises, feet, inches, and lines of Paris. The French measure and that of Florence, engraved on brass, are incrufted in the pavement of the church, exactly under the centre of the dial. They were regulated by the demi-toise of iron which I carried into Italy ; and the latter had for its standard *
the

* I fupposed at that time, with M. de Mairan, (fee Memoirs of the Academy of Sciences, 1735, p. 157 ; and 1747, p. 499 and 500) that the toise was equal to the iron rule which M. Godin, M. Boguer, and myself, carried to Peru in 1735, to ferve us in the menfuration of the terrestrial degrees, and of which I left a model with the academy. This model and our toise had been compared and found to be equal in one of our afsemblies. The year following, that is to fay, in 1736, the model depofed was carried by M. de Maupertuis and his colleagues into Lapland, where it ferved them in their menfuration of a degree of the meridian, in-

D 2

ter-

the toise which M. de Mairan made use of in his experiments of the pendulum.

I left in like manner at Rome the length of the same toise on the entablature of a stone balcony in the façade of the palace belonging to the academy of painting, sculpture and architecture in France. The iron toise sent by M. de Mairan to the fathers Maire and Boscovick, jesuits, in order to serve them in their mensuration of a degree in the ecclesiastical state, is exactly comprised (when M. Reaumur's thermometer points at 1014) between the two vertical faces and parallels of the two notches made

perfecting the polar circle. But the toise of M. de Mairan has been since discovered to be shorter than ours by about the tenth or twelfth part of a line; some allowance being made for a more accurate examination.

by

by a rule in the cylinders of porphyry fixed in the entablature of that balcony, with a projection of half an inch, which forms a standard proper for cutting another rule, whether of wood or metal, of the exact length of a toise. If we would take the same measure with a pair of compasses, instead of carrying their points on the projecting parts of the two notches, which is as difficult as it is inconvenient, we ought to make them correspond with two very fine parallel lines, traced with a diamond, on the horizontal surface of two porphyry cylinders, in the prolongation of the inscribed ray.

It is only in the present century, and even within these thirty years, that on account of some new experiments regarding the length of a pendulum for seconds and the new mensurations of

the terrestrial degrees, undertaken by this academy, we have perceived the necessity of carrying our precision to the most scrupulous exactness in the making out of instruments that are intended for measuring, and it is true also that it is only in such cases we have need of so great a precision. The models of the ancient measures were divided only into digits, without any lesser subdivision. What is this in effect, but a line more or less in a fathom or an ell, destined to measure the length of a wall or piece of stuff. They very much neglect inches in common surveying, and likewise in masonry. There would be nothing astonishing then at all in it, though there should remain an uncertainty of a line or more with respect to the length of an ancient measure, such as that of the cubit, or of the Greek and Roman foot: the latter is particularly the subject of our present enquiry. We have no true
model

model left us of it ; and though we had, could we be certain that the length of the Roman foot was not changed at different times? Were the measures of the ancients secure from those accidental variations, which the more usual ones among the moderns, such as the toise and ell, are liable to? They found themselves under a necessity of reforming the first in 1668, and of shortening it by five lines. We are ignorant whence this error proceeded ; and what is perhaps still more singular, we are able to find no other vestige of this reformation of five lines, than a bare mention of the fact, in the short treatise *de mensuris* of M. Picard, tom. VI. of the ancient memoirs of the academy*, and a word or two more in the mensuration of a degree by the same author. All those who

* Page 536.

have ever mentioned it since, have done nothing more than quote this academical. It is true that we saw at Paris, about two years ago, an old standard of iron, defective and erroneous, fixed in a stone pillar, in the angle next to the stair-case of the great chatelet, and that we even still see there a standard of the new toise, also of iron, and fixed in the interior pillar of the arcade, by which we ascend to the said staircase. It has not yet been stolen *, as the old one was ; but what would scarce be believed out of France, no inscription has ever been set up to tell us either what one or the other is, nor wherefore, or at what time, they were placed there. Besides, that which now remains there, in this respect like the old one, which no longer exists, is so rudely made, the angles of the

* So said in 1762.

two ends or points which terminate this standard are so very much worn, whether by the frequent use made of it, or the injuries of the air, or any other accident, that two toises measured upon this model, though by the same person, would not be found equal, unless it were by very great chance*. Since the reformation made under the inspection of M. Picard, whose name alone is sufficient to make us presume upon the greatest accuracy, we find he was himself mistaken in near six toises, with respect to the very fundamental basis of his labour for the mensuration of a degree; and his error is a proof that the toise he made use of for

* See the new project of an universal measure, published in the Memoirs of the Academy of Sciences, for the year 1747, p. 500.

measuring his base was too short by near a line *.

M. de la Hire has found the ell of Paris so very different among the several bodies of tradesmen, that some of them make it, as he says, four lines shorter than others †.

The ell established by the edict of 1557, was fixed at three feet, seven inches, eight lines; yet the iron standard of this measure, kept since the year

* This error, which was found out in 1740, has been since verified in 1757, by the new measurements of the commissaries of the academy. See the meridian of Paris verified, sect. I. Art. I. p. 33. and following. Mensuration of three degrees of the meridian, p. 252. and following. Memoirs of the Academy for 1754, p. 185.

† Memoirs of the Academy for the year 1714, p. 398.

1554 in the merchants hall, was but three feet seven inches and near eleven lines of the reformed toise made in 1668. This point was not cleared up till 1745, on the examination and proof made of it by Mess. Camus and Hellot, of this academy, authorised by the ministry *. They moreover found this standard very rudely made, and still worse divided, by reason of its large, unequal and crooked strokes, and in short too long by more than a third of a line, at the entry of the two projections made for embracing such measures as should be presented there for trial.

After what I have just observed, shall we be at all surprised, that amidst the ancient feet, preserved at Rome, there

* See Memoirs of the Academy for the year 1746, page 607, and following.

should be any found, which differ from each other by more than a line? It is now near a century ago since Mess. Picard and Auzout gave in their proportion of a Roman foot to that of Paris, that is to say, such as they concluded it to be; the one from a comparison of several testimonies, the other from his own observations made upon some antique sculptured feet. Since that time they have discovered at Rome several others, as well sculptured as of metal. These are all different from one another, and have been differently rated for three centuries past by the learned, by curious travellers, and by antiquaries. In doing this, the greater part of them employed their own national measures, the proportions of which to ours are not perfectly settled*,

* Memoirs of the Academy for 1747, p. 498.

and

and each of them likewise made use of a foot, the authenticity of which has been tried and proved by none of them. On one side the several models differ sometimes a line or more ; on the other, the several observers agree not sometimes by nearly two or three lines with respect to the length of the very same foot*.

* Ebutius's foot, according to Fabretti, contains $133\frac{1}{3}$ lines ; according to father Revillas, $131\frac{1}{2}$; according to the Abbé Barthelemi, and father Jacquier, in 1756, $130\frac{2}{3}$, being near three lines less than what it is made by Fabretti. The same gentleman found the feet of Statilius and Cossutius equal ; M. de la Hire thinks they vary by near half a line. See the *Dissertation of the Academy of Cortona*, tom. III. p. 125 ; and *Memoirs of the Academy of Sciences*, 1714, p. 395 ; and *Memoirs of the Academy of Belles Letters*, tom. XXVIII. p. 609.

I should

I should have as much right as another to report here my own particular measure of the several ancient feet that are known, and to draw from thence a new determination of the length of a Roman foot, but that I have not the presumption to think it at all better than any of the foregoing, and that it would serve perhaps only to multiply doubts. I thought my time would be better employed if I should be able to remove to Paris the originals themselves, or, in default of them, their models *en creux*; which I caused to be made on the four ancient Roman feet, preserved in the Capitol, viz. those of Statilius, Cossutius, and Ebutius, and that which has been since found near the Villa Corfini, and presented to the cabinet of the Capitol by the marquis Capponi, whose name it has retained. I speak not of those portable feet of iron or brass, which
 ·rust,

rust, verdigrease, and even use alone may have rendered too short. The question here is only concerning feet that are found sculptured in bas relief. I took care to let the plaster dry on the original reliefs, that the models in drying might preserve, if possible, their just length*. I have deposited these moulds, since the reading of this memoir, in the king's cabinet of medals, under the care of the Abbé Barthelemi. Thus we may for the future at Paris, as well as at Rome, examine and compare these four

* It were to be wished that in cases like this, we could employ for the mould a matter as proper as plaster for receiving the impression, but more solid, and capable of acquiring, at least for a time, a greater degree of hardness. Such a composition would not be impossible perhaps to be found, and would merit the researches of any lover of the arts, more dexterous and fortunate than I can pretend to be.

measures one with the other, and draw the same inferences from them, as if we had the very originals, such as they now are, before our eyes. That is to say, on the inspection alone, and still more upon the tryal, any person may be convinced as I am, 1st. That the sculpture of these feet, whether upon stone*, or upon marble, has never been delicate enough, even before the projecting parts of the relief of the angles were impaired and worn down by age, to have enabled us, at any period, to regard these monuments as faithful standards of the ancient foot: and in fact, whatever appearance a sculptor, or rather a stone-cutter, charged to carve in a rough

* The foot called Ebutius's, is not carved on marble, but on a stone called *Peperino*, which is more porous, and by a great deal less fine, than marble.

manner a sepulchral monument may have pretended, or even been able religiously to give to the just length of a Roman foot, in the representation of a symbol, destined only to point out the profession of the architect mentioned in the epitaph; That 2dly, by the strongest reason in the state of alteration, in which these pretended models of a Roman foot now are, it is not possible to perceive evidently what has been their primitive length. 3dly, That they are also visibly unequal among themselves, and thus that we cannot by means of them arrive at any more exact calculation of the Roman foot than is given of that of Paris, when we pretend to determine its length by those broken feet of wood which our workmen commonly make use of, and which frequently differ among themselves by more than half a line: furthermore on this supposition

fiction can they have more conformity with one another than the several antique feet in the Capitol, in which the very bixel alone may cause a much greater difference?

If any thing could seem proper to clear up the debate relative to the measures of the ancients, it would be without doubt an old plan of a city, many of whose ancient edifices may still exist, or at least may be distinguishable in their vestiges. In 1573, they found in the ruins of a temple of Romulus, which forms at present the church of St. Comus and St. Damien, at Rome, the shattered remains of a plan of that city, engraved on marble, about the time of the emperor Septimius Severus. These fragments, which at first were collected with avidity, but afterwards neglected, have remained in oblivion for
near

near two centuries in the palace of Farnese; and it is only since the year 1742, that, thanks to the cares of the reigning pope (Benedict XIV.) who begged them of his Sicilian majesty, what remained of them was removed to the Capitol, and divided into twenty-six tables, which at present line the walls of the great stair-case.

At the sight of this monument, to which they have annexed a scale of brass, incrusted in the first table of the fragments, and designed to measure the distances of the plan, I conceived great hopes; and my first care was to try the accuracy of the scale. The inscription set upon it in 1742 imports, that this scale was drawn from a comparison of the ancient monuments, at present subsisting: *Tabulæ I. adjēta est compendiaria pedum antiq. Rom. LXXX. mensura,*

sura, ex eorumdem fragmentorum collatione cum veteribus ædificiis deprompta:
 i.e. “ To the first table is added a com-
 “ pendious scale of 80 feet of the ancient
 “ Roman measure, drawn from a com-
 “ parison of the said fragments with some
 “ old buildings.” However, I found
 on the first trials, that this scale but ill
 agreed with the true measure of such
 monuments as are most clearly de-
 scribed. The author of the inscription,
 as well as those who presided over the
 restoration of the fragments, were
 dead *. After many enquiries, I at
 last found out the person who had
 made the scale of the plan. This was
 the sieur Nolli, author of the best and
 largest plan we have of modern Rome,

* These were the marquis Capponi and father Revillas.

which

which was magnificently engraved in 1748. I learned from his own mouth what means he made use of for forming this scale; and I perceived, on a new examination, the little dependence that was to be made on the conjectures by which he had been determined, and convinced him of it. Leaving all other proofs then rest there, it is sufficient to observe, that the scale which he has annexed to the plan is equal to six inches and near two lines of our foot, and that it measures therein a distance of eighty ancient feet; whence it would follow, that the whole plan, of which they have collected only some fragments, would be nearly a hundred feet diameter *, Paris measure, which
is

* Rome contains upwards of 3000 paces, or more than 15,000 ancient feet, from the Flaminian

is impossible, seeing that the total diameter of the temple of which this plan formed the pavement, and which I measured myself, is but forty-four feet eight inches. In short, the more closely we examine the most perfect fragments of this ancient plan (I say the most perfect, for a great number of them having been either lost or dispersed since its first discovery, have been repaired after the engraving of Bellori, which comprehends only the lesser part) the more we shall be convinced, that the inartificialness of the execution, and the little exactness of the work,

nian gate (now called *del Popolo*) to the Porta Capena (at present that of St. Sebastian), and 80 feet being $187\frac{1}{2}$ part of 15,000 feet, this distance of 15,000 feet would have been measured on the antique plan by a scale $187\frac{1}{2}$ long, which answers to upwards of 96 feet, Paris measure.

renders

renders it absolutely of no service towards clearing up the debate relative to the ancient measures. I shall not enter into a detail of the different proofs which I might produce on this occasion, and which alone would furnish sufficient matter for a memoir; I shall only add, that if I had had any doubt left, I should have been confirmed in my opinion by that of the Abbé Barthelemi, whom his own particular researches, and the new observations which we made together at Rome, have led to the same conclusions as myself. Since my return into France, I have seen that this was also the opinion which M. Piranesi delivered with regard to this antique plan, almost all the fragments of which he has engraved anew, in that great work of his which he has just published on the antiquities of the Romans, in four
large

large volumes folio *. Nothing can console us better for the present ruinous state of this monument, than the little real value it is of, and its unserviceableness, which has been so well proved, towards adjusting the measures of the ancients, even though it were entirely preserved.

* This antique plan is so defective in itself, that it is of less importance to observe here, that the engravings of Bellori are far from being exact, and that they seem as if made at sight; the distances and number of columns in the temples and other edifices, the proportion of the lines, the opening of the angles in them, being frequently very little conformable to the original. I must say the same of the engravings of M. Piranesi, which are visibly copies, and even negligently done, of those of Bellori; without doubt, because M. Piranesi judged that the time which it would require to execute them with greater exactness would be pure loss.

It

It is very probable, that the fundamental dimensions of any large edifice, when they have not been confined by the ground, contain a round, or at least an entire number of small measures; that the two axes, for instance, of the ellipsis of the Coliseum, that the diameter of the Pantheon, that the façade of the baths of Diocletian and Caracalla, have rather an entire than a broken number of Roman feet. This reflection, which naturally presents itself, suggested to me a method which appeared to me proper for determining the true length of a Roman foot. With this view I took, as accurately as possible, some capital dimensions of the most celebrated monuments at present existing in Rome, and I sought which of the measures attributed to the Roman foot, divided the total length without any remainder; but this expedient,

E which

which has not even the merit of novelty *, did not succeed with me ; for when all the inferences I proposed drawing from it were made, I perceived that I ought not to expect any greater precision in it, than from the measure of one solitary foot taken separately. This is what I believe has not been remarked before ; but be that as it will, the following is a proof of its truth.

First, this method is not exempt from difficulty. I suppose, that the interior diameter of the Pantheon, the

* See M. Picard's treatise *de mensuris*, already cited (*Ancient Memoirs of the Academy of Sciences*, tom. vi.) *Memoirs of the Academy for 1714*, p. 396, &c. I shall give, however, the result of my endeavours for this purpose, at the end of this memoir, and the several evaluations of an ancient Roman foot, which we may draw from them.

area of which is circular, may be a hundred and fifty Roman feet. This it ought to be, according to all appearance, from the very first stratum of the stones of the foundation, that this diameter may have the said round number of ancient feet, and not at the surface of the ground; and yet it is only on the surface that we can take our actual measure. Secondly, suppose it be granted, that this length should be taken at the surface, yet ought it at least to agree with the exterior, rather than the interior diameter of the walls of the temple; but it is the latter only that is accessible; the exterior can only be concluded upon by deducting the thickness of the walls; and this thickness can be measured only at the gate, where it is by no means the same as in the rest of the contour. Thirdly, as-

the city of Paris, I measured scrupulously at Rome, with a chain of iron equally extended on the pavement, four radii of the Pantheon, taken from the centre to the axis of four columns, opposed to each other, two and two. I proved at Paris these measures, which I had noted down on the same chain, and marked with a file. I employed in this verification the toise which had been made use of in the mensuration of a degree of the meridian beneath the equator, and the assistance of the Sieur Canivet, a maker of mathematical instruments. The difference between the two radii, taken from North-east to South-west, is near four inches ; but the total diameter is equal nearly within an inch to that which crossed it at right angles ; and one with another they are a hundred and thirty-seven royal feet, and one or two inches.

The

The celebrated Desgodets has measured twelve of these radii with his usual exactness. Among them are some that differ seven inches, which would make upwards of half a line difference in a Roman foot. The length of my diameter exceeds the medium diameter of this architect by no more than between four and five inches, adding to his three feet five inches for the radius of the two opposite columns, which is not comprised in his measure. Fourthly, and lastly, and this reason alone is decisive, the longer measures have been determined only by the multiplication of the figure of which they are composed ; that is to say, by the successive application of this figure to the extent of the ground. A long measure, therefore, will not yield any greater precision than a small one. If the architect, for instance, had wanted to give a

E 3 diameter

diameter of a hundred and fifty Roman feet to the Pantheon, he would have measured them with his own footrule, applied a hundred and fifty times to the ground, or, if you please, with a longer rule, such as a fathom, or a toise. Now this measure, whatever it had been, could not have been divided but by a foot; and what proof have we that this foot would have been more exactly cut than the old feet in the Capitol, which differ among one another by more than a line? An error, therefore, proceeding from any little want of accuracy in the architect's foot, would have been multiplied a hundred and fifty times over in the total length of the diameter of the Pantheon. The same error might still have been increased by any bungling operation in the repeated application of this foot, already defective in itself; and we must not imagine, that errors

com-

committed by applying any measure negligently to the ground, will within a little compensate for each other: That only holds good when they are sometimes more and sometimes less; but an erroneous manner of proceeding, when it is uniform, must multiply the error of which it is the cause: Thus, for example, the application of a toise upon the ground, when we set it down or take it up, by laying it alternately on its opposite faces, necessarily makes us count too much to each length of it, by the thickness of the rule.

These reflections are sufficient to convince us, that we are not to expect any greater precision or uniformity in the determinations of a Roman foot, formed upon the geographical mensurations of an ancient mile. An evident

E 4 proof

proof also, that the toises of the ancients have been negligently measured, with feet neither exact nor equal among themselves; and that, in short, many errors have crept into them, may be drawn from the unequal distances of their miliary stones, which we yet find standing on several old highways, as well in France as Italy, and from the various lengths of a Roman mile, which have been concluded upon from them. But shall we be astonished at finding a few paces difference in the length of a mile, when we see several inches difference in columns of only three or four feet diameter, in the most beautiful ancient edifices?

As for the method employed by Vil-
lapandus, and some others, for de-
ducing the length of a Roman foot
from the capacity of the *Congius*, or
any

any other hollow measure, it is still more susceptible of error than all the preceding ones, on account of the multitude of figures that enter into this determination. The conclusions also which have been drawn this way, are such as carry us still farther from the medium given by other calculations.

After all the learned researches which have been made for three centuries past on the Roman foot, it appears that the subject is now quite exhausted, and that we cannot hope for any thing more than an approximation to it, which leaves at least an uncertainty of half a line. To speak only of the calculations of the moderns, M. d'Anville, in his treatise of itinerary measures, published in 1741, after weighing all the testimonies that had fallen beneath his notice, fixes the Ro-

man foot at 10 inches, 10 lines, and $\frac{6}{10}$, or 130 lines $\frac{6}{10}$ of the Paris foot. Father Revillas, in a learned dissertation on the Roman foot, inserted in the Memoirs of the Academy of Cortona, printed at Rome in 1751 *, taking a medium between the different calculations of an ancient foot, drawn from the several feet now subsisting, as well in marble as in metal, and the geographical measures, gives it two tenths of a line more than M. d'Anville, or 130 lines $\frac{8}{10}$. M. Freret, in a posthumous dissertation, printed in 1756, gives the preference to Statilius's foot †, which he looks upon as the medium between all the different ancient feet; and he supposes this foot to be 131 lines $\frac{2}{10}$.

* Tome iii. p. 122.

† Memoirs of the Academy of Belles-Lettres, tom. xxiv. p. 490.

Father Boscovick, in his mensuration of a degree of the meridian, printed at Rome in 1755, adopted the opinion of M. Stuart, in his dissertation on the obelisk lately taken up in the field of Mars, and gives to the Roman foot 131 lines complete, or 10 inches 11 lines of our foot. This is the medium between the two foregoing calculations of Father Revillas and M. Fréret. The Abbé Barthelemi and Father Jacquier, in 1756, since my departure from Rome, have measured the four sculptured feet, and likewise one of metal; three of which they find equal to 130 lines $\frac{6}{10}$, and this is the length they allow to a Roman foot. Hitherto the several measures agree nearly to within half a line, and their medium scarce varies from the measure of an ancient foot, which Luca Petto, a celebrated Roman lawyer, caused to be engraved,

by authority of the government, about three centuries ago, on a marble which is preserved in the Capitol; a measure which may be estimated at 130 lines $\frac{3}{4}$. But Mess. Hellot and Camus having fixed the ell of Paris * at 43 inches, 10 lines, $\frac{4}{5}$, or $\frac{5}{6}$, agreeably to the researches which they made concerning it in 1745, on an old standard belonging to the Mercers company, of the year 1554, they have found out that the Roman foot, which we have strong reasons to take for the fourth part of our ell, should be 10 inches, 11 lines, $\frac{7}{10}$, or 131 $\frac{7}{10}$ lines of the Paris foot. Lastly, M. de la Hire, in the memoir already cited, makes the Roman foot still longer, and equal to

* Memoirs of the Academy of Sciences for the year 1746, p. 617.

11 of our inches, or 132 lines. We cannot deny but these authorities are of very great weight; however, as M. de la Hire reasons only on the measures taken by others, and his determination differs widely from all the preceding ones, this decision ought not to carry it over the multitude of contrary testimonies. As to the calculation of Mess. Hellot and Camus, it is founded on two suppositions, that are very controvertible: One that the standard of the ell of 1554, which is inartificially and unequally divided, should be a faithful copy of the older standard, which had been preserved without variation since the days of Charlemagne; the other, that the ancient Roman foot should not have undergone any alteration when this emperor fixed the measures at the beginning of the ninth century. All these things being well considered,

it

it appears that by making the ancient Roman foot to consist of one hundred and thirty-one lines, that is to say, of ten inches eleven lines of our royal measure, or perhaps a little less, we shall not be very remote from the truth, and that we shall retain nearly, within a very little, the medium between the several slight variations to which we may suspect the Roman foot has been subject.

I have brought from Rome the actual measure of the two columns of Trajan and Antoninus, as also of the façade of the Pantheon and some others, taken with as much precision as if these monuments had even been transported to Paris. I mean here by the words actual measure, a length equal to the thing measured; leaving it to any one who shall think proper to take the trouble, to determine the number

ber.

ber of feet and inches contained in this length. The following is the method observed in taking it:

I let an iron chain charged with two or three pounds weight of lead, in form of a sounding plummet, hang down from the platform of the chapter of the pillar, till the lead so fixed to the chain rested on the pedestal of the pillar; then I marked with a stroke of a file the part of the chain which answered to the level of the chapter; the other dimensions are in like manner set down on the chain. By letting it hang at freedom charged with the same weight, we shall find the same length precisely, when the thermometer points to the same degree, as I observed it did then at Rome, that is to say, eleven degrees beneath the point of congelation. We may transfer these measures to a wall, and even trace

trace out on it horizontally, and within the reach of the eye, the profiles of these columns with their several dimensions, and of course put it in the power of all curious persons to satisfy themselves in taking the height of them, more commodiously than they could even on the original itself.

The Campagna of Rome, formerly so well peopled and filled with delightful places, is at present desert, and the air there reputed pernicious. We scarce meet now with a few villages, or hamlets, in an extent of ground which once contained twenty-five cities or towns; I speak of the country inhabited by the Volsci, of which Velitræ, now Velletri, was the capital. It is the same with all the environs of Rome: they are uninhabited, especially during the hot months,

except

excepting a few elevated places, such as Tivoli, Frascati, Albano, &c.

I endeavoured to inform myself with respect to an opinion so generally propagated, of the pretended mortal danger of exposing one's self to the air of the Campagna of Rome in the hot weather ; and I am convinced that this danger is not greater than that which we run in every other country that is moist and marshy. What they alledge for the most part concerning the air of Rome and its environs, is very little more than an old prejudice ; very just indeed in its principles, but which it is time to restrain within its proper bounds, by examining its original and foundation.

It was after the invasion of the Goths in the fifth and sixth century, that this corruption of the air began to manifest
itself.

itself. The bed of the Tiber being covered by the accumulated ruins of the edifices of ancient Rome, could not but raise itself considerably. But what permits us not to doubt of this fact is, that the ancient and well preserved pavement of the Pantheon and its portico, is overflowed every winter; that the water even rises there sometimes to the height of eight or ten feet; and that it is not possible to suppose that the ancient Romans should have built a temple in a place so low as to be covered with the waters of the Tiber on the least inundation. It is evident then that the level of the bed of this river is raised several feet; which could not have happened without forming there a kind of dikes or bars. The choaking up of its canal necessarily occasioned the overflow and reflux of its waters in such places as till then had not been subject to inundations; to these

over-

overflowings of the Tiber were added:
 all the waters that escaped out of the
 ancient aqueducts, the ruins of which
 are still to be seen, and which were en-
 tirely broken and destroyed by Totila.
 What need therefore of anything more to
 infect the air, in a hot climate, than the
 exhalations of such a mass of stagnating
 waters, deprived of any discharge, and
 become the receptacle of a thousand
 impurities, as well as the grave of se-
 veral millions both of men and animals?
 The evil could not but increase from
 the same causes, while Rome was ex-
 posed to the incursions and devastations
 of the Lombards, the Normans, and
 the Saracens, which lasted for several
 centuries. The air was become so in-
 fectious there at the beginning of the
 thirteenth century, that pope Innocent
 III. wrote that few people at Rome ar-
 rived to the age of forty years, and that
 nothing

nothing was more uncommon there than to see a person of fixty. A very short time after the popes transferred the seat of their residence to Avignon : during the seventy-two years they remained there, Rome became a desert, the monasteries in it were converted into stables ; and Gregory XI. on his return to Rome, in 1376, hardly counted there thirty thousand inhabitants. At his death, began the troubles of the great schism in the west, which continued for upwards of fifty years. Martin V. in whom this schism ended in the year 1429, and his first successors, were able to make but feeble efforts against so inveterate an evil. It was not till the beginning of the sixteenth century that Leo X. under whom Rome began to resume her wonted splendor, gave himself some trouble about re-establishing the salubrity of the air ; but the city being shortly after besieged

sieged twice successively by the emperor
 Charles the Fifth, saw itself plunged
 again into all its old calamities; and
 from eighty-five thousand inhabitants,
 which it contained under Leo X. it was
 reduced under Clement VIII. to thirty-
 two thousand. In short, it is only since
 the time of Pius V. and Sextus V. at the
 end of the sixteenth century, that the
 popes have constantly employed the ne-
 cessary methods for purifying the air of
 Rome and its environs, by procuring
 proper discharges for the waters, drying
 up the humid and marshy grounds, and
 covering the banks of the Tiber, and
 other places reputed uninhabitable,
 with superb edifices. Since that time a
 person may dwell at Rome; and go in
 or out of it at all seasons of the year.
 At the beginning, however, of the pre-
 sent century, they were still afraid to
 lie out of the city in summer, when

5

they

they had resided there; as they were also to return to it, when once they had quitted it. They never ventured to sleep at Rome, even in broad day, in any other house than their own *. They are greatly relaxed at present from these ancient scruples: I have seen cardinals, in the months of July and August, go from Rome to lie at Frascati, Tivoli, Albano, &c. and return the next or the following days to the city, without any detriment to their health: I have myself tried all these experiments, without suffering the least inconvenience from them: we have even seen in the last war in Italy, two armies encamped under the walls of Rome, at the time when the heats were most violent. Yet notwithstanding all

* They cannot at Rome compel a tenant to dis-lodge in summer, even on default of payment.

this, the greater part of the country people dare not still venture to lie during that season of the year, nor even as much as sleep in a carriage, in any part of the territory comprehended under the name of the Campagna of Rome.

M. Lancisi and M. Leprotti, physicians to the popes Clement XI. and XII. as well as M. Lapi *, have strenuously combated, both by reason and experience, the abuse of this old prejudice, but it is only by insensible degrees that the truth begins to prevail. It must also be confessed that the experiments made for

* See *Joan. Mariæ Lancisi Dissertatio*, &c. or the Dissertation of Joanna Maria Lancisi, concerning the natural and adventitious qualities of the Roman climate, published at Rome in 1711; and the *Ragionamento contrà la volgare opinione*, &c. da *Giovani Girolamo Lapi*. Romæ, 1749.

proving

proving an air that is reputed mortal not to be so, are necessarily very few, and no less foreign from the end proposed.

I hastened to pass from Rome to Naples before the great heats should come on: I arrived there too late to be a witness of the eruption of Mount Vesuvius. The first object then of my curiosity was the subterranean city of Herculaneum, buried beneath the ashes of that volcano, now for near seventeen centuries, and discovered at the beginning of the last, but on which the attention of the publick has not been fixed till within these few years.

The most valuable beyond doubt of all the monuments which are admired there, is the great number of manuscripts on Egyptian paper, blackened and almost calcined, and nearly in the same
state

state as if drawn out of an oven. They have found out, however, the art of unrolling them, and of gluing the leaves on a very thin pellicle; happily they are written but on one side. They are now labouring to transcribe these manuscripts, which it requires only time to do: They will, no doubt, hereafter succeed so far as to interpret them; they are all Greek. The characters of those I have seen are very distinct; I have read, without difficulty, many words in them, and even entire lines.

Next to the manuscripts, the thing that struck me most, was the great number and variety of household utensils and little family moveables, many of which resemble ours: And it is necessary to remark here, that hardly any but those made of metal have

been able to last so long. I saw, among other things of this kind, silver dishes embossed, with their sub-cups, in the form of our coffee-dishes. But these things have already afforded matter to abundance of writings; and antiquities are not here my object. I shall confine myself, therefore, to some reflections on the state of certain mechanical arts among the ancients, and on their progress among us.

They have found antique drinking-glasses, several of which are of different forms, together with bottles; which alone would prove, that the ancients knew how to found and blow glass, and even that they had a sort white enough to make window-panes of. One step farther, and they had discovered, as well as we, the method of rendering blown-glass flat, and of making
it

it into squares. Nor would they then have remained destitute of that greatest of modern conveniences, which we enjoy almost without perceiving it; *viz.* of those windows and glass doors, which let in day-light to us, at the same time that they preserve us from all the injuries of the air; which exhibit to us, even in the interior part of our houses, the variegated view of nature; and which transform the winds, the frosts, the tempests, into a magnificent moving picture before our eyes.

The Romans, however, were still far from the art of running glass, and making it into mirrors. There was a necessity first of bringing the matter and the method of fusing it to such perfection as that it should imitate crystal; then to know how to plane and polish this purified glass, before they

could think of fixing its transparency by a leaf of tin impregnated with mercury. It appears, that they had not even the art of tinning metals, though they knew extremely well how to apply gold and silver to them. In fact, the statue and horse of Marcus Aurelius at the Capitol were gilt; a great number of family utensils (let us dare to call things by their names), the very kitchen furniture found at Herculaneum, is frequently silver, but never tinned over. It is the reverse with respect to solder; we find none among any pieces of antiquity in silver, but only in tin; and as this kind of solder is weak, we see nothing more of it than the shattered remains.

I must not forget the lace made of gold wire, found in this subterraneous city. It is of pure gold, and wove
like

like cloth. They had not yet so much as set themselves about thinking how to substitute instead of a gold thread a thread of silver gilt, which should be as beautiful, lighter, and of a price greatly inferior to the other. For a very strong reason, they had never taken any thought about sparing again in the materials, without losing any thing in the outward lustre, by making flat the said thread of silver gilt, and rolling it round a filken thread. The Romans were very far from foreseeing that the time would come when an ounce of gold would be sufficient to gild a thread of silver six leagues in length.

Among the great number of rings and precious stones set in signets, found at Herculaneum, I do not know that they have met with one diamond. Very

few are seen that are antique; without doubt, because they have been retailed upon us by the moderns, as fast as they have discovered them. If some passages of Pliny and Isidore give us reason to think that the ancients made use of the fragments of the diamond to engrave on hard stones, and to fashion even the diamond itself, it does not appear that they had made any great progress in the art of bringing the natural facets to perfection, of multiplying, and of polishing them with its own proper powder. I have seen no antique diamonds that had not their own genuine points, such as they come out of the hands of nature, after having had the outward coat taken off. The coloured stones found at Herculaneum are mounted in gold, but very clumsily. I have seen there signets of amethyst, and among these stones, one of an oblong

oblong form, about fifteen lines in length, very straight, and cut *en Goutte de Suif*; as also emeralds, several of which were engraved, some *en creux*, others in relief, together with onyxes, cornelians, &c.

If we have any superiority over the ancients in the practice of certain arts, it is not at least in that of cutting and fashioning these hard stones. I have seen with admiration little vases of rock crystal, the mouth of which is so narrow, that the inside could not have been made hollow as it is, without much industry and patience; and I doubt whether, with greater advantages, our workmen would have succeeded therein better. There cannot be any art of more antiquity than this. I saw in the cabinet of baron Stoch, a celebrated antiquary at Florence, a cor-

nelian fit for setting in a signet, on which were engraved the seven heroes of the ancient Theban war, with their names in Greek characters. We know not at present any precious stone that is engraved, of a higher antiquity. It is believed to be of the time of the Trojan war ; but the origin of this art is still more ancient. It was common in Egypt before the going out of the Israelites, seeing they had among them lapidaries and engravers in fine stones : We find the proof of this in Exodus *.

* “ And thou shalt take two onyx-stones, and
 “ grave on them the names of the children of
 “ Israel. . . . With the work of an engraver in
 “ stone, like the engravings of a signet, shalt
 “ thou engrave, &c.” Exod. chap. xxviii. v.
 9. 11.

In

In the publick monuments of antiquity, decency is seldom violated. It is not the same with those designed for the use of private persons, and the interior decoration of their houses. As the Pagan religion was no restraint to debauchery, the ornaments of painting, sculpture, moulding, and carving, in the household furniture of the ancients, instead of that seriousness and gravity which our veneration for antiquity leads us to seek for there, frequently present either obscene objects, or the caprices of a wanton and trifling imagination. I happened to be present when they brought to the cabinet of antiquities at Portici a tripod of brass, which had just been discovered, and which far exceeded all that had been found there before : It was as remarkable for the beauty of the work, as the impudence of three figures of satyrs,

which supported the seat. I was at that time taken up in considering a monument of another kind, viz. a little limb of silver, weighing two or three ounces, on which was delineated a dial, or the horary lines; the numbers in it, which marked the hours, and the initial letters of the names of the months were distinctly engraved; the tail of the animal whose thigh was represented in the limb, served as a pin to the dial. I had neither permission nor opportunity to examine for what latitude this dial was made, which was so much the more difficult to determine exactly, as the smallness of the ray did not permit any great precision in the angles. We shall be the better able to judge of it when all the monuments found at Herculaneum, which are to be engraved and described, are published.

published. The draughts for this purpose were very far advanced in 1755.

I shall add very little to the experiments made by the Abbé Nollet * on the vapour of the grotto del Cani near Naples. Emboldened by his attempt, I laid my face close to the earth, and drew in at different times the vapour, which rises there in a thick smoke from six to seven inches above the surface of the ground. A dog thrown into the grotto loses the use of all his senses in less than a minute. I felt as it were a small smarting over the eyes; and, on presenting my tongue to it, an impression somewhat piquant, without any distinct flavour; I found also

* See Memoirs of the Academy of Sciences for the year 1752, p. 75, 76.

something strong in my throat—I dare not call it acrid, yet it had nearly the same effect as when we snuff up a weak volatile salt; but I perceived no smell in it. Finding myself at a loss when I wanted to write down in my journal what effects I had experienced there, I returned the next day to the grotto, in order to examine the matter again. I went there even a third time, on the day following, accompanied by father de la Torre, a religious of the Sommascenes, and at present librarian to his Sardinian majesty. I repeated the same experiments: I drew in the vapour thrice successively, my nose touching the ground, and felt the same sensations as the first time; that is to say, nothing very distinct as to the odour or taste; but something very penetrating and suffocating.

M. Reau-

M. Reaumur's thermometer, with spirits of wine, which the same morning, between six and seven, had marked eighteen degrees in my apartment at Naples, being laid flat in the bottom of the grotto for half an hour, ascended twelve degrees, and fixed at thirty above congelation, by nine in the morning. This heat, as we see, is somewhat less than what is sometimes felt at Paris even in the exterior air. The same instrument ascended to the fortieth degree in the hot-houses near San Germano, where I found by experience that even the pains of rheumatism were suspended. Another thermometer of the like graduation, but made with mercury, being exposed in the same place, exceeded not thirty-nine degrees. A little farther, the same instrument plunged into the large shoot of boiling springs of Pisciarelli, to the
North-

North-east of Solfatara, scarce reached sixty-nine degrees, so far was it from exceeding eighty; which would have been the case, if it were true, as is commonly said, that these springs are hotter than common boiling water.

There might, without doubt, some curious researches be made here by a physician, who should have leisure to examine the bowels of Montenuovo, a small mountain about a hundred toises high, which started up out of the earth in one night in the year 1538, near Puzzuoli, during the time of the eruptions of Vesuvius.

The 4th of June 1755, I had the honour of accompanying his serene highness the margrave of Bareith to the summit of the mountain, and even to the brink of the funnel which had
formed

formed itself round the mouth of the volcano since its last explosion. This funnel was opened amidst a heap of cinders, calcined stones, and sulphur, which still burned here and there, tinging the very sun with its colour, and exhaling through divers crevices. The heat was so considerable in some places, over which I passed very quick, that I felt it across the soles of my shoes: I walked round this rampart of cinders, and having plunged a staff, between four and five feet long, into one of the clefts, I drew it up again all in a flame.

I went close up to the edge of the crater, in a place where it was most accessible, and which appeared to me to be steepest on the inside. There I laid me down on my belly, and stretched my head forward, in order to examine

mine the inside of this gulf, the smoke of which prevented me from seeing the bottom. At such times as the wind dispersed it, I could see down to the depth of forty toises or more, and I perceived therein a large arched cavity towards the north-east of the mountain. I caused great stones to be thrown into this cavity, and counted by my watch twelve seconds before the noise of their rolling ceased to be heard. At the end of their fall, his highness the margrave, and several others, thought they heard a noise resembling that which a stone makes when it tumbles into a slough; and when we cast nothing in there, they heard a kind of boiling, like the sound of agitated waves.

In ascending the mountain, I had the mortification to see my portable barometer

rometer break in the hands of my conductor, at the very instant when I was on the point of reaping the fruit of the trouble it had given me by its carriage from Paris. The shortness of my stay at Naples did not permit me to repair this loss; nor to measure geometrically the height of Vesuvius, which has never been well determined *. Father Torre obtained the necessary permission for me to observe the height of this mountain; but his friendship and obligingness could not remove other difficulties. This father has just published a new history of Vesuvius, in which the gentlemen of the faculty will find wherewith to satisfy their curiosity †.

* I have been assured, that there is no dependence to be laid on the account given of it in the Memoirs of the Academy of Naples.

† This history has been translated into French.

The eruptions of this volcano have been frequent for many years past, and every time that it darts forth its flames, and vomits out its liquid matter, the exterior form of the mountain, as well as its height, receive considerable alterations.

In going down, I stopped on a rising ground, in a small plain resembling a half-moon, called *Atrio di Cavallo*, situated between the mountain of cinders, the stones cast out of the bosom of the volcano, and a semicircular theatre of steep rocks, two hundred feet high, which fortify this little place or valley on the north side. There I viewed closely the breathing-holes lately opened in the sides of the mountain, and through which, at the time of its last eruption, those torrents of inflamed matter had escaped, to which
they

they give the name of *Lava*, and with which all this valley is filled.

This singular spectacle presents us with the appearance of metallick waves grown cold, and in a state of congelation. One may form a slight, but very imperfect idea of it, by supposing to ourselves a sea of thick and tenacious matter, the waves of which were beginning to subside. This sea had its isles; which are solitary masses, resembling hollow, spongy rocks, opening into arcades and grottos, fantastically formed, beneath which the burning liquid matter has made itself magazines or reservoirs, not unlike furnaces. These grottos, with their vaults and pillars, all the pure work of nature, were loaded with scoria, suspended around them in the form of stalactites, or irregular clusters of grapes, of all
 sorts

forts of colours and shades. I broke off several of the most remarkable fragments, which I carried to Naples, from whence they have not yet reached me now in two years time; thanks to the officious zeal of three different persons, who contended for the pleasure of sending them to me *.

Both in ascending and descending the mountain, I had all the necessary time to examine the matter of the lava in its various states. I continued this examination in my several trips to Portici, a bourg situated at the foot of Vesuvius, where the king of the Two

* They are since safely arrived at Marseilles, together with some other pieces of natural history; but no part of them is yet come to my hands, notwithstanding all the trouble I have been able to take.

Sicilies has a house of pleasure built on the ground which covers the ruins of Herculaneum.

They do not comprehend under the name of lava all the various sorts of matter which issue out of the mouth of the volcano, such as the cinders, pumice stones, sand, gravel, &c. but only those which, being reduced by the action of the fire to a state of liquidity, form on cooling solid masses, in hardness surpassing even that of marble. But notwithstanding this restriction, it is to be conceived, that there will still be found many very different species of lava, according to the different degree of fusion in the mixed matter, according as it participates more or less of metal, and becomes either more or less intimately united with the various kinds of materials of which

which it is composed. I have distinguished, in particular, three general species, and there are, no doubt, many intermediate ones. The purest lava looks, when polished, like a stone of a dirty, obscure grey : It is sleek, hard, weighty, and interspersed with small fragments resembling black marble, having whitish specks ; it seems to contain metalline particles ; at the first glance of the eye it looks like the serpentine-stone, excepting that the colour of the lava approaches not towards the green ; it receives also a pretty fine polish, which is more or less lively in its different parts. Tables, Chimney-pieces, and even snuff-boxes are made of it. I have seen at the court of Naples tables of an inch in thickness, some of which were veined and warped like a plank. The coarsest sort of lava is uneven and rugged, and greatly resembles

resembles the scoria of a forge, or the
 dross of iron. The more common
 lava preserves a medium between these
 two extremes. It is this sort that we
 see diffused in large masses on the sides
 of mount Vesuvius, and in the adjacent
 fields. There it has run in torrents,
 and formed, on cooling, masses like
 rocks, of a ferrugineous and rusty co-
 lour, and oftentimes many feet in
 depth. These masses are broken, and
 sometimes covered over with heaps of
 calcined matter, shot forth out of the
 bowels of the volcano, and which fall
 again in the form of rain. The salts
 they contain mingling with the dried
 leaves of the trees, vines, and other
 plants, with which the mountain is co-
 vered, and with the dung which they
 carry there, form in time, and fre-
 quently in the interval between one
 eruption and another, a new bed of
 earth,

earth, extremely fertile, which another stratum of lava covers again in its turn. It is beneath several of these alternate beds of lava, cinders, and earth, all which put together form a crust of between sixty and eighty feet thick, that they have found temples, porticos, statues, a theatre, and even an entire city.

I never was acquainted with the matter of the lava in America, though we frequently encamped for weeks, and even whole months, on the volcanos there, and particularly on those of Pitchincha, Coto-paxi, and Chimborazo. I saw on those mountains only the vestiges of the calcination, without the liquefaction. However, the kind of crystal vulgarly called in Peru *Piedra de Gallinaço*, several pieces of which I brought along with me, and
a polished

a polished lens of which, about seven or eight inches in diameter, may be seen in the cabinet in the king's garden, is nothing else but a species of glass, formed in these volcanos. The matter of the torrent of fire which runs down continually from that of Sangai, in the province of Macas, to the South-east of Quito, is, without doubt, a lava ; but we saw this mountain only at a distance, and I was not at Quito at the time of the last eruptions of the volcano of Coto-paxi, when a kind of fustiracles * opened on the sides of the mountain, from whence was seen to issue in waves an inflamed and liquid matter, which must be of the like nature with the lava of Vesuvius.

Journal of the Voyage of James Oglethorpe

* See the Historical Journal of a Voyage to the Equator, printed at the Louvre in 1751, p. 156, and following.

It is well known, that Naples is paved with this lava; but it is surprising that nobody has yet remarked that the pavement of Rome is also composed of the same materials. I may say as much of the pavement of the greater part of the ancient Roman highways, and perhaps of all those of which any vestiges are remaining from Rome to Naples, as well as on the road from Naples to Puzzuoli and Cumæa. In short, it is the same with the Appian way, which still subsists, and makes a part of the high road from Rome to Naples. This antique pavement is entirely composed of lava.

We shall be less surprised at this, when we come to know that the foundations of the houses in the subterranean city of Herculæanum, built now two thousand years ago, are pure lava.

This

This is sufficient to determine a question discussed in the Academy of Belles-Lettres, and proves evidently that the great eruptions of Vesuvius are not all of them posterior to that which swallowed up the city of Herculaneum. But though this city is, in fact, buried under several strata of lava, properly so called, yet we must not imagine that its streets, its squares, and its buildings, are covered with lava: Were this the case, neither the pick-axe nor chisel would be able to penetrate there. The matter with which the interior parts of the city are filled, has never been either fused or liquid. It is only one immense mass of cinders, earth, gravel, sand, coal, pumice-stones, and other materials, launched forth through the mouth of the volcano at the time of its explosion, and fallen again in heaps in all the circumjacent parts. These at

first buried all the houses; by degrees they penetrated into the interior parts, as well by their own proper weight, as by the assistance of the wind and rains, and lastly, by the roofs and timbers giving way. This mixture being united by the infiltration of the waters, has condensed in process of time, and formed a kind of sand-stone, more or less hard, but every where easy to be dug through. Such is also the soil of the heights which command Naples to the North and to the West; viz. those of Capo di Monte, the castle of St. Helena, and the Charter-house, but more particularly the steep hill which we see on the sea-shore, as we go out of the city to the West. Such again is the soil of the eminence into which is dug that famous subterranean antiquity, above half a mile long, known under the name of Pausilyppo's grotto.

All

All the mountains and hillocks in the environs of Naples will visibly appear on an examination to be nothing more than a mass of various sorts of matter, vomited forth by volcanos which no longer exist, and whose eruptions, anterior to history, have probably formed the ports of Naples and Puzzuoli. But it is not in Naples only, and its neighbourhood, that I have found the like kinds of matter. My eyes being accustomed to distinguish the different emanations of Vesuvius, and especially the lava, under all its various appearances, discovered it, beyond room for doubt, on the whole road from Naples to Rome, and even at the very gates of the latter, sometimes pure, sometimes mixed, and combined with other materials.

All the interior part of the mountain of Frascati, on which stood Cicero's Tusculum, the chain of hills extending from Frascati to Grotta-Ferrata, Castel Gandolfo, and as far as the lake of Albano, a great part of the mountain of Tivoli, together with those of Caprarola, Viterbo, &c. are composed of several beds of calcined stones, pure cinders, scorias, gravel, and materials resembling dross of iron, baked earth, and lava, properly so called; in short all like those of which the soil of Portici is composed, and those which issue out of the sides of Vesuvius, under so many different forms. One may distinguish by the eye all these several substances: the cinders may be discovered both by their colour and taste. It is impossible for any one, who examines with attention the productions of Vesuvius, not to observe a perfect resemblance between them and those which

we

we meet, every step we take, on the road from Naples to Rome, and from Rome to Viterbo, Loretto, &c. It follows then necessarily, that all this part of Italy has been overturned by volcanos. These plains which at present appear smiling and fertile, covered with olive-trees, mulberry-trees, and vineyards, as are also to this very day even the sides of Vesuvius, have formerly been, like them, over-run with burning waves, and like them bear, not only in their bowels, but even on their surface, the vestiges of those torrents of fire, the billows of which are at present grown cold again and condensed: irresistible testimonies of vast conflagrations anterior to all historical monuments.

I pretend not to revive the system of Lazzaro Moro, a Venetian author, whose work (printed at Venice in 1740). I was

not so much as acquainted with, when I made the tour of Naples. He asserts that all islands and mountains wherein are found marine bodies, and of course the continents which serve as bases to these mountains, have all sprung out of the bosom of the deep, by the efforts of subterranean fires. History furnishes him with proofs for a pretty considerable number: the rest he concludes by induction. His assertion, the truth of which I am unwilling to deny, is too general to be completely proved: I confine my own to simple facts, and draw from thence only the necessary consequences. When I see in an elevated plain a circular basin surrounded with calcined rocks, the verdure with which the neighbouring fields are covered imposes not on me; I instantly perceive there the ruins of an ancient volcano, as I should perceive beneath the snow itself
the

the traces of an extinguished fire, on seeing a heap of cinders or coal. If there be a breach in this circle, I usually find out by following the declivity of the ground, the traces of a rivulet, or the bed of a torrent, which seems as it were hollowed in the rock ; and this rock when examined closely, appears frequently to be nothing more than lava, properly so called. If the circumference of the basin has no breach, the rain and spring waters which assemble there, and have no issue, generally form a lake in the very mouth of the volcano.

The representation alone, on a topographical chart, of the lake of Albano, with its steep sides and circle roughened with rocks, called to my remembrance the lake of Quilotoa, which I have else-

G 5 where

where described *, and whose waters sometimes exhale fumes of fire. A few days after, the sight of the lake of Albano itself, and the calcined matter with which its banks are powdered, left me no room to doubt any longer of its origin. I saw manifestly the profound funnel of the shaft of an ancient volcano, in the mouth of which the waters had accumulated themselves. Its eruption, of which history makes no mention, must have been anterior to the foundation of Rome, and even of Alba, from whence this lake has taken its name, a period amounting to near three thousand years.

At the sight of the traces of fire diffused in the environs of the lakes of Bor-

* Historical Journal of a Voyage to the Equator, page 61.

fello, Ronfiglione, and Bracciano, on the road from Rome to Florence, I had formed the same conjectures, before I had seen either Vesuvius or the matter which it vomits forth. I pass the same judgment by analogy on the lake of Perugia, and several others in the interior parts of Italy, which I know only by the map.

In short I look upon the Apennine as a chain of volcanos, like that of the Cordilleras of Peru and Chili, which runs from north to south, the whole length of South America, from the province of Quito to the Terra Magellanica. The course of the volcanos of the Cordilleras is interrupted: a great number of them are either extinguished or smothered; but several still remain actually burning. The old ones also frequently revive, and sometimes new ones are kindled even in

the bottom of the sea ; nor are their effects, on that account, less fatal. In a few years time both Lima and Quito, two capital cities of Peru, became the victims of these two kinds of volcanos. The chain of those of the Apennine, which divides the continent of Italy, in like manner from north to south, and extends as far as Sicily, presents us still with a pretty great number of visible fires under different forms ; in Tuscany, the exhalations of Firenzuola and the warm baths of Pisa ; in the Ecclesiastical State, those of Viterbo, Norcia, Nocera, &c. in the kingdom of Naples, those of Ischia, Solfaterra, and Vesuvius ; in Sicily, and the neighbouring isles, Ætna or Mount Gibel, with the volcanos of Lipari, Stromboli, &c. But other volcanos of the same chain being either extinct or exhausted from time immemorial, have left only some remains behind ;

behind ; which although they may not always strike at the first sight, are not at all less distinguishable to attentive eyes. In short the earthquakes which have at various times overturned several of the cities of Italy and Sicily, that which swallowed up the city of St. Euphemia in 1638, and of which Kirker has drawn so pathetick a picture, that which destroyed Catano in 1693, that which opened the gulfs of Palermo in 1718, that which since the reading of this memoir has overturned Syracuse, recall to my remembrance the disasters of Valparaíso, Callao, Lima, and Quito, in South America, and close the parallel between the Cordilleras of Italy and those of Peru : the marks of resemblance between them are but too striking.

I affirm not that all these mountains are in the same state with the Apennines.

I have

I have not observed the same appearances in that part of the Alps which I traversed, but I have found some similar ones in Dauphiné, Provence, and several places where they have never yet been regarded as proceeding from the action of fire *. It is not then in Italy alone that we find vestiges of calcination and vitrification in places where volcanos have never been suspected. The same may be said of

* In 1760, three years after the reading of this memoir, I brought from Balaruc, a village of Languedoc, situated on the sea shore, and celebrated for its warm waters, fragments of a porous stone, calcined like a pumice, but hard, blackish and weighty, and in all respects resembling the coarsest sort of lava, or rather those stones which floated in the lava while yet liquid, which are impregnated with it, and sometimes confounded with the lava itself.

France,

France, and perhaps of every other country. My conjectures on the ancient volcanos of Italy, the traces of which I saw every where, and the lava, which I found beneath my feet, in places where it had never been suspected, seemed to me so evident, that all my astonishment was, that they should appear new ; nevertheless they were thought whimsical, not to say ridiculous, in a country where I am still of opinion, that in order to form the like, it is sufficient merely to open one's eyes. I learn, that they will probably be better received in France : it will require no difficulty to believe that a great part of Italy is covered with the shattered remains of ancient volcanos that are unknown to us, and with lava, properly so called, in all respects like that of Vesuvius, seeing that M. Guettard, whose memoir, published in
my

my absence*, I was entirely ignorant of, has discovered a perfect resemblance between this matter and those which he has found in Auvergne, on a comparison made by him of the fragments of the lavas of Vesuvius and Mount Gibel, which had been sent from Italy, and the different lavas which he has discovered on the mountain of Volwick, on the Puy de Domme, and on the Golden Mountain.

I learn still farther that they build at Clermont, in the same province, with a porous and yet very hard stone, which I suspect to be of the same nature with the stone of Tivoli (*Lapis Tiburtinus*) now Travertino, used in the most an-

* Memoirs of the Academy of Sciences for 1752, printed in 1756.

cient edifices of Rome, such as the prison of the Tullianum, built under Tullus Hostilius. This stone bears marks of the action of fire upon it, and is a kind of coarse and porous fragment, seemingly impregnated with a mixture of heterogeneous matter. In another stone very common at Rome, and which they call there *Peperino*, we see incorporated pieces of white marble, resembling that which we frequently find whole veins of on the mountain of Vesuvius, and in the clefts of the rock bordering on the little plain in the Half Moon, which I have already mentioned: one may distinguish also in the same stone, which may possibly be nothing more than a less pure sort of lava, fragments resembling black marble. In the last eruptions of Vesuvius, pumice and other stones half burnt, have been seen floating on the surface of the burning
and

and liquid lava. It must often come to pass that stones plunged and retained by some obstacle within the liquefied mass, are penetrated to all intents by the various fused materials of which the lava is composed. I have brought home a coal, which I drew out of the cavities of a stone, in the castle of Citta-Castellana, one day's journey from Rome. To what other cause can we more naturally attribute the interior disposition of certain rocks, such as are seen in divers places on the coast of Genoa, particularly to the north of Cape Mela? The rock there is cut as it were with a pick-axe, and its vertical section discovers all the inside: we see in it a jumble of several matters differently coloured, which are not disposed in strata, but wavey, and in the form of eddies, whose aspect alone recalls to our minds the idea of some kind of marble papers, and seems as if these materials

had

had been surpris'd and fix'd in their state of bullition. What is then that species of sand or dust found in the environs of Puzzuoli, which is commonly call'd Puzzuolaneum, and great quantities whereof are found in many other places where it is not known, but an amalgama of calcined stones mingled with scorias and iron rust reduced to powder? I am also very much tempted to believe, that the black and metallick dust, so common in America, and on which M. Muffchenbroek made several experiments *, is a production of volcanos.

* M. Muffchenbroek, in his dissertation on the loadstone, informs us, that the sand, on which he tried his experiments, came from Virginia. I found it in all parts of Peru, and it is very common in the province of Quito.

But

But however the case be with respect to these last conjectures, they have nothing in common with what I advance on the subject of the pavement of Rome, the Appian way, &c. I repeat it, that in order to perceive the same matter there as the lava of Vesuvius, it needs only eyes: as for those which require authorities to support them, I shall cite Wagner, a learned naturalist, and physician to her royal highness the margravine of Bareith, whom I found of the same opinion with myself, when I communicated to him my thoughts on the materials of the pavement of the Roman highways in the environs of Naples and Rome. He added to me, that in three different journeys from that capital to Florence, he had observed from the mountain of Radicofani, those several species of calcined matter, which I myself had begun to observe, only from the environs of
Aqua-

Aqua-pendente, and the resemblance of which to the lava of Vesuvius I was not yet acquainted with. Another suffrage no less decisive in a similar case, is that of M. Soufflot, comptroller of the king's buildings. Since the reading of this memoir at the publick recital, I have learned from him, that in his last tour to Italy in 1752, he went to Capo-di-Bove, half a league's distance from Rome, out of the quarry at which place the pavement of that city is drawn; and that he perceived that this pretended stone differed not at all from the lava, with which the streets of Naples are paved. The same material might be drawn from a place much nearer to Rome than Capo-di-Bove; for I myself have seen pure lava as we go out of the city, and that too very near the gate of St. Sebastian, on the road from Frascati to Rome. It is astonishing that a
fact

fact so easy to be verified, should still, especially at this time of day, have the air of a paradox, and not be more generally known.

The prince of San-Severo, gentleman of the bed chamber to his Sicilian majesty, knight of the order of St. Januarius, and celebrated for his knowledge in various branches of literature, as well as for his taste in chemistry and the arts, furnished me with a sight at Naples of some attempts towards a new species of a very short vegetable silk, which they had not been able till then to succeed so far in as to spin. They extract it from a tree which grows in the country, the leaves whereof differ very little from those of the Sallow-tree, and which by botanists is called *Apo-cynum*, or Dogs-bane. This silk very much resembles that which is drawn

from a large tree in America, called *Fromager* (or the cheese tree) in our isles, and *Seyba* by the Portuguese of Parà. They make no manner of use of it in the French colonies: but I saw it employed at Parà, in the making of feather beds. The prince of San-Severo has given me some patterns of this silk thread, and likewise of the stuff which he had caused to be made of it. It is of the colour of fire, and looks like a waled, watered tabby, that is very thick: It takes no lustre, but by passing under the calandar.

Naples had a few years ago an academy of sciences, a volume of whose labours has even been published. The zeal of a few individuals gave birth to it; but it subsisted not long, for want of proper regulations and protection. They talked in 1755 of forming a history,
under

under the authority of the government, for describing and explaining the antiquities of Herculaneum: And we have since seen appear two volumes in folio, containing explanations of these monuments, published by the said society.

Travellers usually choose to make the tour of Naples at the time of the feast of St. Januarius, when they are desirous of being made eye-witnesses of a fact as extraordinary as it is true; and which is held in that country for supernatural. They expose then, on the principal altar of the cathedral, the head of St. Januarius, bishop of Naples. They place near this relique a phial of crystal, set in a very rich mounting, and which, according to tradition, contains the blood of St. Januarius. This phial is shook for some time, and ordinarily, after several shakings,

shakings, the matter contained in it appears to liquefy before the eyes of all present ; I say ordinarily, because it does not happen so always, and at such times the people of Naples are thrown into the greatest consternation. I lamented that I had quitted Naples without having been present at this solemnity, when chance, in some measure, made me amends for it. Being gone one evening to pay my court to her royal highness the margravine of Bareith, a phial was brought to that princess, set in a circle of brass or silver gilt, and mounted on a pedestal very richly ornamented, which was surmounted again with a caduceus, in order to distinguish the mounting of this from that of the phial kept in the cathedral. All this apparatus was put in the hands of the princess, from whence it passed into those of the mar-

H grave,

grave, and several other persons, as well as into mine; and the following is a true account of what we all saw. The phial appeared to be half filled with a gray-coloured fixed mass or paste, and its sides tarnished with dust. On inclining it alternately several ways, and shaking it for about half a minute, more or less, the paste became liquid, and melted; sometimes only partially; at other times it grew fixed again, and on shaking it anew it was either a shorter or longer time in liquefying. All this was done before our eyes; and what is still more deserving of notice, in such a manner that neither the will nor desire of the person who shook the phial could promote or produce either the one or the other at his discretion. This is what I have been an eye-witness to on several occasions, not only the evening I mentioned, in presence
of

of their highnesses, but since more particularly, and in broad day, at the keeper's of the machine, where I had all the necessary time to examine it. I observed beneath the phial two small cones, I know not of what material, with their points opposed to each other, which he informed me were perforated with a small opening. He further added, that they were hollow, and that the lower cone was moveable, in such a manner that its orifice sometimes met with that of the upper cone, and at other times did not; all this was purely accidental, and just as the motion impressed on the phial caused, or not, the axes of the two cones to concur. As for the dust which I saw in the phail, they told me it was an amalgama of mercury, lead, tin, and bismuth; that the bismuth, which mingles but very imperfectly with the other ingredients,

H 2 prevented

prevented the mixture from becoming an absolute fixed paste, and gave it the form of a powder too thick to pass through the little opening which communicated with the two cones. Lastly, they added, that in a circular channel, concealed in the mounting, was contained some running quicksilver; that by shaking the phial irregularly, when the orifices of the two cones met, this mercury insinuated itself in a greater or less quantity, and liquefied the amalgama; that it came to pass sometimes, that by the variety of motions impressed on the machine, the mercury, so introduced, returned again by the same opening, and that then the amalgama ceased to be fluid. I relate with all possible exactness what the possessor of this ingenious machine told me, and which I also set down in writing the same day: All that I can certify

certify for fact is, that it performed its operations extremely well. He promised me at that time an exact description of it, together with a draught of all its parts, to be communicated to the Academy. He has since renewed the same promise to me in writing, but has not yet fulfilled it *.

At

* This memoir, read in the Academy in 1757, was not printed till 1762.

Mr. Addison calls this whole affair of the liquefying of the blood of St. Januarius one of the most bungling tricks he ever saw. Mr. Addison's word would have gone as far as any man's; yet I must confess, for my own part, that I have never read the short account he gives of it, but I have always wished, that he had shewn us wherein it was bungling. M. de la Condamine, with that happy curiosity for which he is so remarkably distinguished, has here explained the whole juggle, upon such mechanical principles, as, though they entirely destroy the credit of the

H 3

miracle,

At my return from Naples to Rome, Cardinal Valenti, minister and secretary of state to his Holiness, did me the honour of putting into my hands six copies of a new Italian translation, done and printed at Rome by his order (though it bears the name of Lucca in the frontispiece) of my memoir on

miracle, yet, at the same time, prove the means by which this wonderful feat is effected to be very ingenious. On this occasion, one cannot but admire the candour of the writer, who, though no doubt a violent Papist, yet is so far from being bigotted to any peculiar mode of thinking, that we owe to him the detection of one of the greatest impositions of the church of Rome. The reader must not be offended, if I go one step farther, and charge Mr. Addison, on the other hand, with an over-weening zeal against the Roman Catholick religion, in calling that trick bungling, which it is plain, even from his own account of the matter, he knew nothing at all of.

the

the inoculation of the small-pox, read the year before at Paris in a publick assembly of this Academy. In the conversation which I had on this subject with his eminence, he gave me to understand, that no theological scruples, ill understood, would be opposed at Rome to the establishment of a practice which tends to the good of mankind. The divines with whom the cardinal-minister had conferred on this head, had taken care to inform themselves of the true state of the question, that no alarm might be taken at any false representation of it; and they delivered it as their opinion, that it was perfectly conformable to the principles of Christian charity, to annihilate, or at least almost to annihilate, that evident risk of death, which every infant that comes into the world is ex-

H 4 posed

posed to during the whole course of his life.

I learned at the same time, that the maternal tenderness which in other places retards the progress of inoculation, had been an incitement to the mothers in some parts of the Ecclesiastical State. The mothers there, without waiting for the hand of the surgeon, inoculated their children themselves, while they were asleep, and even without the knowledge of their fathers, by a simple puncture. Never did operation succeed more happily. The *Journal des Sçavans* of Rome has given us an account of it, in their number for July 1755 *. The same year inoculation was introduced into

* *Giornale di' Letterati*. Luglio, 1755.

Tuscany,

Tuscany, by authority of the government, in the hospital at Sienna; and in the autumn of 1756 into that of Florence. It has actually established itself at Pisa. Doctor Targioni has just published at Florence a relation of his success. This method gains ground, and becomes more extensive every day. From Geneva it has passed over into Swisserland and Germany, where the most eminent physicians have declared in its favour *. Holland, Denmark, and Sweden, have also adopted it. I mention not England, as there it has not one single opponent among the

* M. Vanfwieten wrote me word in January (1757) that he intended to perform several inoculations the spring following. See M. Haller's letter to M. Tissot, entitled, "Inoculation justified." Also a manuscript letter from M. Wherloff to M. de la Virotte.

chirurgeons and phyficians. Behold us then on all fides invefted by inoculation. The Spaniards are the only neighbouring people among whom it has not yet found means to infinuate itfelf. So far we are obliged to them, in that we have not been the laft nation in Europe to adopt fo falutary a practice: But, in the mean time, that the whole nation may reap the fruit of it, we have illuftrious examples before our eyes; one fingle inftance of which proves more in favour of this method *, than a thoufand others, which have only for their principle a fervile and mechanical imitation. Our divines would be afhamed to afk ferioufly, if it be permitted in confcience to make

* The inoculation of his Grace the duke of Chartres and Madam de Montpenfier, his fifter, in 1755.

use of a precaution, the effect of which, as confirmed by new and daily experiments, is to screen annually several thousands of victims from the small-pox, when taken in the natural way. Our bishops and our magistrates know not, that it was an anonymous person who first impeached inoculation at their tribunal; but they are not ignorant, that M. Chais * had beforehand replied in a victorious manner to all the moral and theological objections that had been made to it, dictated by a zeal more ardent than illuminated; and that Father Berti, an Augustine, and one of the most learned divines in Florence, together with several other Catholick doctors in Italy, have publicly under-

* Apologetical Essay on Inoculation, by M. Chais, printed for De Hond at the Hague, in 1754, and sold by M. Briasson at Paris.

taken the defence of the small-pox in the artificial way. There remains then no longer either reason or pretext for alarming the consciences of those, who forgetting the evidence, are determined only by authority.

With regard to the physicians who have openly avowed their writings against inoculation, though their names, their number, and the general tenour of their works may be calculated to impose upon us, yet I shall not insist the less strenuously, that the business of a physician, in point of inoculation, is only to examine, whether the particular habits of the person who presents himself do not render him unfit to reap the benefit of his operation. For this purpose the physician the most skilful and experienced, ought undoubtedly to be consulted in preference to all others. But as to the
ge-

general question, “ whether inoculation
 “ be a salutary practice?” or even the
 other question, “ whether it be ad-
 “ viseable to inoculate infants?” the
 decision of these turns upon nothing
 more than a pure calculation of pro-
 babilities. The problem being reduced
 to this compass, becomes of that kind
 of operations which is common to lot-
 teries, and belongs only to arithmetick,
 inasmuch as to resolve it, we need
 only cast our eyes on the lists of per-
 sons inoculated in the small pox hos-
 pitals, and that for foundlings at London.
 With respect to the calculation of the
 risk by inoculation to adults of different
 ages, the problem there becomes more
 complicated, and the most subtile ana-
 lysis is not able yet to determine it but by
 approximation, on account of the im-
 per-

perfect state of the bills of mortality, especially in France*: but it is not the less evident on that account, that inoculation would preserve to the state a great number of subjects who perish by the small pox in the natural way; nor is it less true, though less evident, that from its being advantageous to the state, it necessarily follows that Providence dictates the use of it to individuals, unless

* In the bills of mortality published in France, they insert the number of the dead, without distinguishing their ages and diseases. In those of London, which are much more perfect than ours, we see on one side how many persons die at each separate age, and on the other, how many die of every disorder; but both these matters are not united again in one point of view, and we see not in what proportion the mortality occasioned by any particular disorder, such for example as the small pox, diffuses itself over persons of different ages.

it be in extraordinary cases. Inoculation henceforward will have for its enemies only those who are not able to attain to this truth, demonstrated as it is; or such as, being convinced in themselves, yet have certain reasons to contend with, which they are afraid to bring to light*.

My

* The whimsical but ingenious doctor Douglas, in his account of the British settlements in America, vol. II. page 398, &c. gives us the following state of the small pox in Boston, from January 1752, to July 24, from whence the proportion between those who die in the natural and artificial way may in some measure be determined, viz.

Small-pox in the natural way, 5059 whites, 485 blacks, whereof died 452 whites, 62 blacks. By inoculation 1970 whites, 139 blacks, whereof died 24 whites, 7 blacks. Thus there died of inoculation 31 persons, not including the dubious deaths of Mr. Coleman's son, who died by subsequent nervous disorders and sore eyes, and the two daughters of Mr. Goldthwait, who died under
ino-

My abode at Rome being prolonged,
and my health re-established there, I
pro-

inoculation, but, as it is said, by the fore throat illness. Died then of an inoculated small-pox, about one in eighty-two whites, and one in twenty blacks. In the Boston small-pox of 1752, there died whites in the natural way about one in eleven; by inoculation one in eighty: blacks in the natural way, one in eight; by inoculation one in twenty. In Charles-town, South-Carolina, when the small-pox prevailed in 1738, upon a scrutiny, it was found that in the natural way, of 647 whites, died 157, which is one in four; by inoculation of 156 whites, died nine, that is to say, one in twenty: of 1024 blacks in the natural way, there died 138, which is one in seven and a half; and of 251 blacks by inoculation, there died seven, or one in thirty-six. In the natural way 1721, died about one in seven; 1730, about one in eight; 1752, nearly one in eleven; 1721, Mr. Bond, a carpenter, and five of his children, died with purples and hæmorrhages in Boston; 1752, four children of Mr. Wier of Charles-town died,
whereof

procured a clock from Paris, with a metal pendulum, whose vibrations lasted for

whereof one was inoculated; 1752, of the small-pox decumbents in Boston, died about one in eleven; 1713, Timonius from Constantinople sent to the royal society in London incredible recommendations of this practice: "that for the
 " preceding eight years some thousands had been
 " inoculated, and none died; while at the same
 " time half of the affected in the common way
 " died in Constantinople; and, what is valued by
 " the fair, inoculation never leaves pits or scars:
 " children have no convulsions." Pylarini, the Venetian consul at Constantinople, in 1714, sent to the royal society a more modest account of the same. Dr. Le Duc, a native of Constantinople, and who was himself inoculated, assured Dr. Jurin, that out of many thousands, in the space of about forty years past, who had been inoculated in and about Constantinople, by one Greek woman, not so much as one person had miscarried. 1721, I lent (says Dr. Douglas) these communications to Dr. Cotton Mather, a clergyman of Boston; being

for twenty-four hours, and the very same with which I had made my experiments

being very credulous, he set a rash operator to work, and about 286 were inoculated, whereof about one in forty-eight died in Boston.

In the spring of 1722, by direction of the princess of Wales, six hospital children, and soon after five more hospital children, from about fourteen weeks to twenty years of age were inoculated; some did not receive the infection, as having had it formerly, or from some other impediments, but none died or suffered much. Upon this encouragement, Mr. Amyand, serjeant surgeon, was ordered to engraft the small-pox on princess Amelia, aged eleven, and princess Carolina, about nine: they had them favourably. This encouraged the practice; and from the accounts of Dr. Jurin, secretary to the royal society (a great promoter of inoculation) in the first three years, 1721, 1722, and 1723, of the practice, in all Great-Britain were inoculated 477 persons, whereof nine are suspected to have died; and as of these twenty-nine did not receive the infection (this is one in sixteen)

the

periments at Quito, at Parà, at Cayenne,
and at Paris. Father Boscovick the je-
suit

the deaths were nine in 448, or two per cent. in this period of three years. In making of medium estimates, we ought to take large numbers in a long series of time, but not the cases of singular families, where some may say that notorious circumstances were not avoided or attended to, such as pregnant women, child-bed women, old negroes, and the like. We had a remarkable instance in the inoculations of Boston 1752, of five persons in one family, Mr. Sherburn's, inoculated by Mr. G—r, three died. Of 72 or 73 persons inoculated in 1721 in Roxbury and the adjacent country towns, by Mr. B—n, five died, which is about one in fourteen. In short the risk seems to be only two to three per cent. and by the purging method, and some prudential cautions, might be farther reduced. In the Boston inoculations, upon an actual survey, it was found that in about 2000 inoculations, thirty-one had died, (others including some disputed cases, say thirty-four) the promoters gave out 3500 inoculated, but gradually reduced the
number

suit, a celebrated geometrician, one of those who measured two degrees of the meridian of Rome at Rimini, procured me all possible conveniences for repeating my experiments on the pendulum in the Roman college, where he had traced out a meridian. These were made and continued again more under his inspection than mine for nine days together, at different intervals. The result was, that in the month of October 1755, my pendulum performed at Rome 9886 $\frac{1}{2}$ vibrations in twenty-four hours middle time, Reaumur's thermometer pointing then at seventeen degrees above congelation. This number being compared with that of the oscillations of the same pendulum at Paris, at Quito, at

number to 3000, and afterwards to 2500, (see the Boston Gazettes, published in June 1752) and at last acquiesced in the actual scrutiny of about 2109.

Cayenne, at Parà, in the same space of time, will give the difference of the length of a pendulum for seconds, in all these places with the greatest precision, by reducing them all to the same degree of the thermometer. I went also several times to the collège of English jesuits there, and to the observatory of father Maire (father Boscovick's colleague in his mensuration of the degrees) in order to observe at these places the immerfions of Jupiter's satellites on the occultation of the stars by the moon. The clouds rendered our preparations uselefs. Astronomers alone know with how many ineffectual observations one that succeeds is purchased. I reserve for another opportunity my experiments on the thermometer, the barometer, and the declination of the magnetick needle, as well at Rome as in divers other places in the course of my tour.

Charles

Charles VIII. at his return from his expedition to Naples in 1495, founded a convent of French minims to the trinity of the Mount, in one of the most beautiful situations in Rome. The clock belonging to this convent is a great consolation to strangers, being the only one in the city by which you can learn what hour it is.

The ecclesiastical day beginning at midnight throughout the whole christian world, and all the rites of the Roman church being regulated by it, it is somewhat extraordinary that the civil day should not commence at Rome with the ecclesiastical, and that Italy alone, with a remarkable singularity, should differ in a point of such common practice from all the rest of Europe. They begin counting the hours in Italy from the end of the day, a time

equivocal, arbitrary, and morally impossible to be determined. This custom favours visibly of barbarism, and recalls to our minds the time when some senseless persons thought they had settled the limits of day and night extremely well, by ordaining that the day should be looked upon as ended when they ceased to distinguish objects. But what objects? at what distance? in what season? and under what temperature of the air? Problems which require as many solutions as there are different objects, different distances, eyes differently formed, and different changes in the air.

From hence it comes to pass that at Rome, and almost throughout all Italy, they count every day at noon one hour different from the evening before ; and that noon-tide, which they nevertheless stand in need of knowing exactly on

ac-

account of their ecclesiastical rites, varies more than three hours from winter to summer. At Rome, in the solstice of June, at the hour of noon, the clock strikes sixteen; but in the winter solstice, in December, nineteen. As the length of the day, especially when taken from the twilight of the evening before to that of the next day, differs from one day to another several minutes; in order to avoid meddling every day with their clocks, they have conceived that they ought to wait till the differences so accumulated, from day to day, should amount to about fifteen minutes: and that they may act conformably to this regulation, all the clocks of the city make a skip of a quarter of an hour on a day appointed, sometimes at the end of eight days sometimes at the end of fifteen, and sometimes after an interval of six weeks. For this purpose a printed
al-

almanack informs us, that from the 16th of February, for instance, to the 24th, it will be noon at a quarter past eighteen, but that on the 24th it will be noon at eighteen o'clock precisely, and continue so till the 6th of March, &c. That from the 1st of June to the 13th of July, the hour of noon is to be reckoned at sixteen o'clock; on the 13th of July at sixteen and a quarter, and so on through the rest of the months; insomuch that in the space of a whole year, the time of noon varies from fifteen to eighteen, and that not by an insensible progression from one day to another, but by skipping a quarter of an hour between a fixed day and the day after, at the end of eight, or fifteen; and sometimes after an uniform march of forty days. I have long considered with myself what advantage can possibly

result to them from so whimsical a custom; and the only one I have ever been able to conceive is, that it is very difficult at Rome to perceive when a watch goes wrong.

We may see that this custom is not only founded on a gross ignorance of the elements of astronomy; but that it is also embarrassing in the practice. Such, however, is the tyranny of custom, that in the country of Galileo, of Kirker, of Riccioli, of Cassini, very few persons will allow that this is the least inconvenience. The most celebrated mathematicians of Rome, and among them the fathers Leseur and Jacquier, French Minims, well known for their learned commentary on Newton, as also the fathers Maire and Boscovick, Jesuits, have been consulted with the view of knowing whether it would be
proper

proper to reform this custom. It is easy to imagine what was their answer. The abuse, nevertheless, still subsists, and will subsist probably for yet a long while to come.

The emperor in his Tuscan territories, and the infant duke of Parma in his, have cut within these few years this Gordian knot, by ordaining that the hours there should be reckoned conformably to the custom universally received throughout the rest of Europe. It is not without difficulty that these princes make themselves obeyed, and the murmurings on account thereof still continue. What adds to the aversion of the vulgar, a name which extends very wide, is, that they have, very unfortunately for the truth, taken it into their heads to call such of their clocks *à la Française*, as mark the hour of the day by beginning

it at midnight and at noon. This title of their being French clocks is by no means calculated to serve as a recommendation to them. Besides, they find it so easy and so natural to count the hours from the end of the sensible day ; so strange and so troublesome to divide the night and the day in the middle, and to regulate the hours by the terms of midnight and of noon, of which there is nothing to inform the senses, that without the aid of authority the old custom had never been changed. It is in the convents of the nuns in particular, that the astronomical method has found it difficult to introduce itself. By the ancient method of computation the hours of all the exercises of the cloister were different every day, or rather went under different names, though in fact they were the same. They went, we will suppose, to matines always at six hours
after

after midnight; but this was ten in one season of the year, and thirteen hours in another. The hour of dinner, which was fifteen in summer, and nineteen in winter, took successively the name of all the intermediate hours, and yet every thing went on well. At present, by counting only from midnight, the nuns enter the choir all the year round at six in the morning; and the clock of their refectory striking daily at noon, every thing appears to them in disorder and confusion.

Rome, as well as the greatest part of the cities of Italy, has several literary societies, which go under the name of academies. These sometimes hold public assemblies, wherein many pieces in verse are read, particularly sonnets, a kind of poetry, the taste for which has supported itself in Italy with the same

vivacity for upwards of these three centuries past. I assisted on the seventh of August 1755, at an assembly of academicians called Quirini, who held their meeting in a grove of the gardens belonging to the palace of Corsini, one of the most beautiful in Rome.

A verdant portico opening into arcades, and supported by rows of trees cut into columns, with their bases and chapiters, formed a large circle round an octagon bason. This rural peristyle was ornamented with steps, and the circumference of the bason with seats, for the numerous audience. In the bottom an amphitheatre still more ornamented arose, which served as a throne to the members. Fronting this, and right before the bason, eighteen very rich chairs of state, placed all in a semicircle, were occupied by the cardinals
and

and ambassadors. This fight, for which I was not at all prepared, struck me greatly. I thought myself transported into Elis, in the happy days of Greece, and that I saw the judges there distributing crowns to the victors in the Olympic games.

The Roman academy for sculpture and painting has just been enriched with some new donations by the liberality of the sovereign pontiff; and very lately also with a school for designing and modelling, supported like that in the French academy, established by Lewis XIV. and which maintains itself still in its full lustre.

But it is surprising not to find in this capital any society for the cultivation of physics and the mathematics: Rome has no academy of sciences. It is even

I 4 but

but a few years since private assemblies have been held (some of which have antiquities for their object) in a city where the most beautiful monuments of the magnificence of the ancient Romans continually attract the attention. To this very hour there are neither funds nor pensions attached to these establishments, which might render them solid, by assuring the lot of those who compose them. Thus we may still say, with respect to those sciences which are termed accurate, as well as with regard to the historical researches, that Rome wants a centre and point of re-union.

The Learned and Antiquarians there are dispersed and divided. There are some, however, particularly in this latter class, who have rendered themselves famous by their works. We are become acquainted with the names of
Bottari,

Bottari, Pacciaudi, Bayardi, Bianchini. Vettori, Venuti, and several others; but many of them young fellows without fortune, who perceiving in themselves a taste and talents for the study of ancient monuments, are obliged in order to raise a small revenue out of it, to devote themselves to the superficial instruction of travellers, and therefore want the necessary leisure for resigning themselves up to studies which are too often very unfruitful: Being thus made jealous of each other, left destitute of every motive of a noble emulation, and less attentive to acquire new knowledge, than to supplant one another, it is seldom that they make any considerable progress, and the greater part of them remain in a state of mediocrity.

Can it be believed that throughout all Italy, where the smallest towns have

a literary academical society, which employs itself in the study of eloquence and poetry, there is but one single academy of antiquities*, and one of sciences? Both the one and the other too owe their birth to the zeal of two individuals for the glory of their country. The first, established some few years since at Cortona, on the frontiers of Tuscany and the ecclesiastical state, by the cares of the late marquis Venuti, brother to the abbé of the same name, whom I have mentioned above, is yet supported only by the zeal of its members, and has already sent into the world six volumes of dissertations: the other, which is more ancient, and better known under the name of the institution of

* The academy of Naples was not yet established in 1755.

Bologna, is the work of the famous count Marfigli, who was at once its founder and benefactor. He purchased the palace for its reception, and has bequeathed to it the celebrated collection of natural history and antiquities of Ulysses Aldovrandus, which had been bought and considerably augmented by him. The reigning pope also, who is a native of Bologna, and was archbishop of it at the time that the Tiara crowned his virtues, honours with his particular protection an establishment which distinguishes that city above all the other cities of Italy. They count there four-and-twenty pensioners, called *Benedetti*, from the name of their foundation.

Among the other favours which his Holiness was pleased to confer on me, the letter of recommendation issued out by him, at his own proper motion,

I 6 by

by virtue of which the academy of Bologna did me the honour of admitting me into their illustrious body, without waiting till the number of places prescribed by their regulations should become vacant, is not to be reckoned among the least.

No church throughout the whole christian world has less need of foreign ornaments than that of St. Peter at Rome, especially since twenty popes, to count only from the time of Sextus V. have with a generous emulation consecrated their treasures towards the embellishment of that edifice. The old custom, however, still prevails, and strangers see with regret and surprise, that on great solemnities they still cover the pilasters of the basilico of St. Peter with hangings that are rich indeed, but the materials and colour of which interrupt the harmony and prospect of a majestick piece

piece of architecture, and deprive the eye of a sight of its marble lining and those other ornaments of sculpture, with which the interior part of that temple is decorated. But be that as it will, this custom of hanging and unhangings so often the church of St Peter, joined with the difficulty of reaching up to its roofs, or even to the arcades of the lower sides, furnishes the Italian artists with frequent opportunities of exercising their talents in the mechanical way. The engraved collection of ingenious and commodious machines, invented in part for the church of St. Peter, by Zabaglia, a person of genius, though but a plain carpenter by profession, is well known. In the month of April 1756, I saw one made by the seignour Giovanni Corfini Roni, but of a construction as simple as elegant, which had just been set up for the reparation of the inside of the dome of the Pantheon.

This

This supplied with advantage the expensive apparatus of those scaffolds, of which we are so prodigal in France, on the like occasions. It was no more than a simple pair of steps, about seven or eight feet broad, and suspended to the summit of the dome. These steps were borne along in a quadrant of a circle, concentrical to the interior part of the dome, and were preserved in their curvature by an assemblage of carpentry-work like that of the cinctures which are used in the construction of roofs; but with this difference, that here, for the greater lightness, straight boards, laid, however, across, supplied the places of square pieces of timber. The summit of the arc was passed through by an iron bolt, which at the same time performed the office of a pivot, and suspended by the same bolt, placed diametrically over the circular opening in the
midst

midst of the cupola, by which the church received its light. The foot of the steps was furnished with rollers, and placed on the cornice of the dome. The whole of this machine, which was near seventy feet high, moved so freely, that it yielded to the first impulse, in going round the cornice; and as it moved about six feet at a time, the workmen were able to transfer themselves with as much convenience as safety to all the heights, and all the different sides of the roof. I understand that there is to be seen at Paris a model of this machine, in the possession of M. Trouart, a young architect, who brought it from Rome.

The spectacle which at present forms the amusement of the people of Rome, retains nothing of the barbarity of the ancient combats of Gladiators. Some of the princes and Roman noblemen
amuse

amuse themselves by keeping horses purely for the course: not as in England, backed by a rider, but alone, at full liberty, and entirely delivered up to their natural ardour and that kind of emulation which the concourse of people assembled seems to inspire into them*.

Eight

* At Florence, in order to increase the speed of the horses, which there also run alone, without a rider to direct them, they place a large piece of leather, somewhat in form of the wings of a saddle, on their backs, stuck full on the inside with very sharp prickles. The barrier being formed, and every thing ready for the race, the spectators immediately set up a loud shout, at the noise of which the horses affrighted start off, and the prickles in the flapping leather on their backs still continuing to goad them more and more as they run, their speed is thus urged to the highest pitch their nerves will allow, till the goal at length happily puts an end to it, by terminating at once the contest and their pain. The barrier they run in
is

Eight or ten horses, commonly barbs, of a small size, and mean figure, retained on the same line by a rope extended about the height of their breast, set off at the instant when they let this rope fall. In the races at carnival time, which are the most solemn, the course is usually in the long street at Rome, to which this exercise has given the name of the *Rue de Course*, or *Race-street*; by the Italians called *il Corso*. They take care at such times to gravel it over: its length is 865 toises *. I observed

is formed by a strong railing, about breast high, with a rope at either end, to keep the horses within the bounds, and the spectators are all placed on seats without.

* That is to say from the rope of the extended barrier, which is 74 feet beyond the obelisk, to the *Porta del Popolo* at the saliant angle of the palace *de Venise*.

twice

twice by means of a watch for seconds, and the help of a signal, that this distance was run over in 141 seconds, which makes near 37 feet a second. A little reflection will make this speed appear much more considerable than at first we may imagine it to be.

It is evident that we cannot suppose more than two leaps or progreffions on gallop to one second, seeing that each of these leaps requires at least three very distinct points of time: viz. that in which the horse lifts himself from the ground, that in which we see him cleaving the air, and that in which he descends again; and that these two bounds, thus supposed to be made in every second, require six definitive moments, a period scarce perceptible in so short a space of time. These horses, which are but of an inconsiderable size, and
whose

whose swiftness every second is equal to thirty-seven feet, pass then at each bound over a space of more than eighteen feet, which is very near equal to four times the length of their body taken from the breast to the tail *. It is true, indeed, that this length is more than doubled

* It is upon principles of this kind that naturalists prove a flea, comparatively speaking, to be the strongest, as well as swiftest animal in being. For as swiftness depends upon a strong conformation of the muscles, of which we have a remarkable instance in the hind legs of a hare, from whence it is well known, that, like deer, greyhounds, and other quadrupeds, she derives her velocity; and as this swiftness again is to be measured by the distance they throw themselves at every bound, compared with the length of their bodies; if we examine the speed and strength of a flea by this method of reasoning, we shall find that instead of four, it is able to throw itself at least forty times its length; a force and velocity ten times greater than that of the barbs at Rome.

by

by the extension which their outstretched gallop gives to their limbs before and behind. All this considered, how can the fleetness of the English horses be by a great deal greater, as it is known in reality to be? But there are certain cases wherein the truth surpasses all the bounds of probability, and of this kind is that at present under our consideration.

The late M. Dufay writ in 1737, from Newmarket, that the course there of four English miles *, of which he had been an eye-witness, had been completed in less than eight minutes by four or

* The English mile was fixed by Henry VII. at 1760 yards or rods of three feet each, consequently this mile contains 5280 English feet, which are equivalent to 4957 of the Paris measure, or to 826 of our toises; the proportion of the English foot to ours being as 1352 to 1440.

five seconds. These miles are 826 of our toises, which makes more than 41 feet $\frac{2}{3}$ in a second, or near five feet more than the barbs at Rome ; and we must also remark here that these latter run at full liberty, whereas the English horses are burthened with the weight of a rider *. This fleetness, however, of 41 feet $\frac{2}{3}$, is still but an ordinary degree of swiftness there, inasmuch as of ten horses which ran together, the very hindmost of them was no more than twelve or fifteen paces from the end of the course. Besides, it is asserted that the same course has been frequently run over in six minutes and six seconds. I have this as a fact from a gentleman who has often been concerned in the races at New-

* The author might have added, that these riders also frequently carry weights.

market;

market*; and this swiftness, which would amount to more than fifty-four feet in a second, is to that of the barbs nearly as three to two. We must also observe, that instead of one English mile, or very little more, to which the course at Rome is limited, that of New-market is four miles, a space too long for the swiftness of any horse to preserve itself through on a sensible equality. It is evident that this swiftness must abate towards the end of the course, and consequently that in the first moments of the race its maximum must be at least upwards of fifty-four feet in a second. We are likewise assured that a famous horse, called Starling, has sometimes performed the first mile in a

* Mr Taaffe, now at Paris. [This gentleman is since dead.]

minute, which would make 82 feet $\frac{1}{2}$ in a second; a degree of swiftness inconceivable, even though we should suppose it to be exaggerated, as there is great appearance it is: But this is a point on which I expect some further elucidations*. It would be sufficient that this

* The following are the elucidations I have received, since the reading of this memoir, from M. (Dr.) Maty, keeper of the library in the British Museum, and author of a periodical work in French, which is greatly esteemed, entitled, *le Journal Britannique*. "There are (says Dr. Maty) two courses at Newmarket, the long and the round: the first is exactly four English measured miles and 380 yards or more; that is to say, 7420 yards or English rods, or 3482 of our toises. The second is not four English miles by 400 yards; that is to say, it is 6640 yards, or 3116 toises, Paris. Childers, the swiftest horse ever remembered, has run the first course in seven minutes and a half, and the second in six minutes forty seconds, which

this swiftness should last only a few seconds, in order to enable us to say without any exaggeration, that such a horse went swifter than the wind, as it is seldom that the most violent wind makes as much ground in the time.

which amounts to 46 feet five, or nine inches French, in the second: whereas all other horses since the foregoing, take up at least seven minutes and fifty seconds in completing [the first and longest course, and seven minutes only in the shortest, which is 44 feet, five or six inches, the second. These (Dr. Maty adds) are facts, which I believe to be true. I must also add, that it is commonly supposed, that these coursers cover at every bound, a space of ground in length about 24 English feet." This is little wide of my conjecture of two bounds in the second. Every bound in this case would be about 18 royal feet and a half, for the fleetest barb in Rome, and twenty-two or twenty-three feet royal for the English running horses; so that the swiftness of the latter to that of the barbs, is very nearly as four to three.

For the greatest swiftness of a ship at sea has never been known to exceed six marine leagues in an hour; and if we suppose that the vessel thus borne partakes one third of the swiftness of the wind which drives it, the latter would still be no more than eighty feet a second.

I departed from Rome on the 22d of April 1756, and took the road to Loreto. I saw on the way the celebrated cascade of Terni, to which Miffon, a pretty exact traveller, gives the height of three hundred feet. I do not believe it has been ever measured with precision, and the local circumstances of its situation render the affair difficult: I should not give it above two hundred feet on a comparison of its total height with that of a part of it, which I myself attempted to measure. This cascade

K

cade appears three times higher than that of Tivoli. The cascade of the isle of Sora, which is less known, because farther removed out of the high road, and which I went expressly to see in my return from Naples, is the lowest but the widest of the three. The Garigliano, which is formed by the re-union of the Liris and the Fibreno, at one mile's distance below this junction, divides itself into two branches, in the place where it meets the rock which forms that isle, and precipitates itself downwards by two cascades; the one perpendicular, about sixty feet high and forty broad, the other much less rapid, but the sight of which is not less singular, nor less agreeable to the eye.

On the 27th of April, being at Loretto, I saw the sun rise from beyond the Adriatick, at about four degrees $\frac{1}{2}$
East

East by North of the compass, from whence I concluded the declination of the needle to be fifteen degrees thirty-five minutes from north to west. I had hoped to have seen, at the rising of the sun, the mountains of Dalmatia, on the other side of the gulf of Venice; but the fogs hindered me from distinguishing them both that and the succeeding days, for the whole length of the coast, which I followed from Ancona as far as Ravenna. By means, however, of the enquiries which I made, I found in these cantons several persons, who assured me, as being eye-witnesses, of another fact, of which till that time I had been uselessly informed : this was, that there are several points of the Apennine, on the frontiers of the Ecclesiastical state of Tuscany, and the duchy of Modena, from whence we may see the two seas

which bound Italy to the East and West*. It was not a vain curiosity which induced me to assure myself of this fact; but the advantage that might be drawn from a concurrence of circumstances, rare, and perhaps only there to be met with.

We have had within these twenty years, five different mensurations of the Latitude † of the earth, but we have

* Among others, from a summit near Borgo San-Sepolcro; and a convent of Camaldulians, near the sources of the Arno, between Val-lombroso and Bagno, on the frontiers of Tuscany and the Ecclesiastical state; and lastly from Mount Cimone, near Sestola.

† In Lapland, Peru, France, at the Cape of Good Hope, and in Italy, completed in 1737, 1742, 1740, 1752, and 1755.

hardly

hardly one of its Longitude *. The apparent impossibility of attaining to a sufficient degree of precision, for want of our being able to find an arc large enough †, parallel to the Equator, and fit for measuring, has almost made us despair of this method. But if any place in the world seems to unite all the most favourable circumstances for measuring an arc in Longitude, it is in this part of Italy.

* By Mess. Cassini, de Thuri, and de la Caille, on the coasts of Provence and Languedoc, in 1742. See the book entitled, the Meridian of Paris Verified, page 105.

† The error to be apprehended in this measure, with respect to the instant of the appearance of an instantaneous signal, not being greater on a large arc than a small one, will make it by so much the less in every degree, as its arc contains a greater number.

A signal placed on one of the summits of the Appennine, from whence we may see the Adriatick to the East, and the Tuscan sea to the West, cannot fail being perceived from one coast to the other, provided it be of a sufficient magnitude. I suppose for instance, that it may be seen from Ravenna or Rimini on one side, and from Leghorn or Pisa on the other. Here then we have an arc of more than two degrees in Longitude, and easy to be measured: but this is not all; for that distance may at least be doubled, of which the following is a proof: from the intermediary summit of the Appennines, from whence we see the two seas, one to the East, the other to the West, the sight can be only bounded by the objects which terminate the horizon of the sea, and which are perceived on both sides. From this same summit then we ought necessarily
to

to see in clear and serene weather the sun rise from behind the mountains of Istria and Croatia, and set beneath those of Genoa. Consequently a sudden flame of a sufficient volume, produced either by a mass of gunpowder, as was proposed by me in 1735 *, and was actually carried into execution in 1740, or by a bomb of pasteboard placed on the summit of the Apennine chosen for that purpose, might in a fine night be seen by two persons appointed to observe it, with each a regulator by him; the one at Monaco, or on the mountains of Genoa, the other on Cape Pola in Istria, near Trieste. The difference of the hour in which each of them would

* See Memoirs of the Academy of Sciences for 1735, page 1; and the Meridian of Paris Verified, page 98.

perceive this artificial phenomenon, will give the difference of the Meridians of the two observatories, and the measure of an arc nearly five degrees in Longitude.

Though we should be able to assure ourselves of this difference of the hour but nearly within a second * (I am of opinion,

* I have found by experience, beneath the Equator, where the stars rise perpendicularly, and with very great rapidity, that it is not difficult, by taking several correspondent heights, to inform one's-self with certainty of the instant of noon, and above all of the mediation of a star nearly within a second; and experienced observers will find perhaps that we may attain to a greater precision. This half-second of time answers to an arc of a degree of seven seconds and a half, which we may estimate beneath the Equator at one hundred and twenty toises, and which would be reduced again to eighty-four toises, under a parallel of forty-four degrees and a half.

Now

opinion, however, that it is possible to attain a much greater degree of exactness,

Now an error of eighty-four toises in an arc of five degrees would not produce one of seventeen toises to a degree, instead of thirty-four, which I have supposed; the following is the reason of it: The difficulty of determining the hour exactly by correspondent heights increases in an oblique sphere, where the apparent motion of the stars is slower; and increases precisely in the same proportion as the obliquity of the sphere, or in an inverse ratio to the cosinus of latitude. Thus, for example, beneath the parallel of sixty degrees, the radius of which is subduple to that of the Equator, the supposed arc of seven seconds and a half would be by a moiety shorter, and consequently would be only sixty toises instead of a hundred and twenty; but the difficulty of taking the hour exactly would be also as great again beneath this parallel, and instead of an error of half a second, which we suppose might be made under the Equator, there would be under the parallel of sixty degrees an error of one second of time to be apprehended, which answers to fifteen

K 5 seconds

ness, if we take all the necessary precautions, and especially if the observations

seconds of a degree. Now an arc of fifteen seconds of a degree half as little, is equal in length to an arc of seven seconds and a half in a degree that is as large again. This would make us then an exact compensation for it, and the error to which we should be exposed in the determination of the hour will be the same under any parallel that we proceed upon : A circumstance which has not, that I know of, been remarked, or at least not explained, till now. It follows from thence, that the exactness of the astronomical mensuration of an arc of Longitude may be equal in every country, and that it depends only on the length of the arc in toises, whatever be the number of its degrees. If I were to confine myself then to the supposition of half a second, at which I estimate, from my own experience, the error possible to be committed in the determination of the hour, by correspondent heights, beneath the Equator, this error would not be proportionally more than forty-two thirds for the parallel of forty-four degrees and a half, and would

tions are often repeated) yet this error of a second in time, which is equivalent

would produce, like that of half a second beneath the Equator, only an error of a hundred and twenty toises on an arc of five degrees; which would be no more than twenty-four toises to a degree, instead of thirty-four, which I have computed. But as the method which I have proposed requires two observers, and it might happen, absolutely speaking, that their errors, instead of being none at all, or less, which I have not supposed them, might be as great as it is possible for them to be, and that instead of compensating one another, they might be doubled, though repeated and multiplied observations might be a remedy, morally speaking, for this accident, yet I have supposed the total error of the two observers to be a whole second, even on taking a medium between their several observations. This second answers not to a hundred and seventy toises on the parallel of forty-four degrees and a half, and yet it is on the supposition of that error, which surpasses all the bounds of probability, that the error in a degree would be,

K 6 and

lent to fifteen seconds of a degree, amounts not in a parallel of forty-four degrees to one hundred and seventy toises, which, being divided again among five degrees, would make only thirty-four toises error to a degree; consequently, the measure of this arc of five degrees in Longitude, would afford as much or more precision than our mensuration of three degrees of the Meridian, which I think I have proved we can answer for, to within very near forty toises*.

and hardly, thirty-four toises. It is evident then that the proposed mensuration in Longitude is susceptible of as great, or even a greater precision, than that of three degrees of the Meridian.

* See the measures of the three first degrees of the Meridian, printed at the Louvre in 1751, p. 232.

If Father Ximenes, the restorer of the Meridian of Florence, be commissioned to make a map of Tuscany, and to measure there an arc of the Meridian, his Geodesian measures, joined to those of the fathers Maire and Boscovich, will extend from one sea of Italy to the other, and go a great way towards taking the proposed mensuration in Longitude, which is so well calculated to furnish us with new lights, respecting the figure of the earth.

My first care on my arrival at Bologna was to acquit myself of the acknowledgements which I owed to the gentlemen of the *Institution*. The count of Casali, one of the professors, and M. Zanotti, perpetual secretary to that illustrious body, were so kind as to give themselves the trouble of accompanying me wherever I went. We
see

see at Bologna assembled in one palace, what, in London, and in Paris, is found dispersed in all quarters of the town, a publick library, enriched every day with new donations from the holy father ; an observatory ; cabinets of natural history, experimental physicks, mechanicks, medals, and antiquities ; vast collections and anatomical preparations, natural and artificial ; halls for academies of painting, sculpture, and architecture, both civil and military, ornamented with plans in relief, and models of machines used in war ; cabinets of geography and navigation : in short, every thing which can preserve a taste for the arts and sciences, and facilitate the progress of knowledge in the human mind. I was present at several academical lectures and discourses. One of their professors of anatomy is Madam Laura Bassi, a lady

lady extremely well versed in the Greek and Latin languages, and wife to M. Verati, another celebrated professor. She is not the only lady in Italy, who in our days has procured herself a name in the republick of letters by her genius and knowledge. We are all acquainted with the treatise on the calculation of differences, by the learned Madam Agnesi of Milan, who has just buried her talents in a cloister; and the learned translations of Madam Ardinghelli of Naples, who at the most tender age distinguished herself by her progress in physicks.

Independently of the lustre which so fine an establishment as that of the *Institution* diffuses over Bologna, that city is one of the largest and most beautiful in all Italy. Every thing contributed to render my abode there agreeable,
and

and indeed I should have needed for that purpose nothing more than the single house of the Felt-marshal Palavicini, late governor of Milan, who had made choice of Bologna for his residence, and from whom I received, without any letter of recommendation, the most flattering advances in my favour. Bologna first set the example, which the greatest part of the cities of Italy have since followed for these twenty years past, in establishing a *Casino*. This is the name which they give to a large handsome house, furnished and maintained at the common expence of the nobility of the city. The best company of both sexes assemble there every evening, and strangers of note, when once they have been presented, are afterwards admitted. Bologna is governed as a republick by the authority of a senate. The popes, to whom

whom this city submitted herself voluntarily many ages ago, enjoy there the honours and the sovereignty; but the Bolognese have preserved their privileges. They have an ambassador in ordinary at Rome, and unite the advantages of a republican form of government to those of a monarchy.

I have spoken above of the Meridian of Bologna, and its leaning tower, which attracts the attention of travellers.

After taking a hasty view of Reggio, Modena, and Parma, and believing myself in France at Colorno, where I had the honour of paying my court to his royal highness the infant duke of Parma, and likewise to the infanta, I passed on to Mantua and Ferrara, from whence I repaired to Venice at the end of May, in order
to

to be present at the ceremony whereby the doge annually espouses the Adriatick, a time there of festivity and tumult, and very ill adapted to observations which require ease and tranquillity.

Amidst the several curiosities which they shew to strangers, in the small arsenal at Venice is a piece of cut velvet, on a ground of gold, as singular for its workmanship as its antiquity. This was a present of Ussum-Cassan, king of Persia, to the republick of Venice, to which he sent ambassadors in 1572. The gold ground is of a flattened stuff, as if it had been passed under the cylinder; the fur of the velvet, however, is raised; it represents not branches or flowers of striking colours like ours, but human figures, pretty well designed, and the draperies
and

and carnations of which have shades enough to imitate the natural. This effort of art, which we should find it difficult perhaps, at this very day, to push farther, may enable us to judge how very long ago that of working silk has been carried to perfection in the East. And what proves clearly the superiority of the Orientals in this kind of workmanship, or at least their great progress in it, before the Europeans, is that this present of a powerful monarch to the republick of Venice, supposes evidently, that this species of velvet manufacture was unknown in that city, at a time when her silken manufactures, which had made those of Greece decline, were at their highest degree of reputation.

The art of making silk tissues, which is very ancient in the East, had passed
over

over into Europe under the Roman emperors. But being banished into the remotest parts of Asia, after the invasion of the Barbarians, who destroyed the Empire, this beautiful art was brought back again to Constantinople, in the sixteenth century, by some monks who were on their return from Serinda, which lies between the rivers Indus and Ganges. The manufactures of filken stuffs established in Greece, and transported into Sicily by Roger, about the year 1148, were brought to perfection at Lucca, at Bologna, and at Venice, in the following century, three hundred years before the first pair of silk stockings, which were presented to Henry II. appeared in France. They knew then that the leaf of the mulberry-tree was the most proper food for silk-worms, but they erroneously imagined, that mulberry-trees would not
grow

grow any where but in a warm climate; and this single prejudice deferred for many ages their transplantation from Sicily and Calabria into the North of Italy. Since those times we have seen them succeed extremely well in France, and even in countries situated much farther to the North : An instance which ought to encourage all proper endeavours to naturalize in our climates such useful productions as nature has refused us.

From Venice I took the route of Turin, but stayed only a few days at Padua and Milan, the latter of which is one of the most pleasing cities in Italy to strangers, and that wherein the French are the least so of any; the manner of living there comes up much nearer to that of Paris than in all the other cities of Italy.

The

The celebrated Ambrosian library contains, among other treasures, between nine and ten thousand ancient manuscripts, a great number of which are oriental, and brought from Greece, Syria, and Egypt. They are all bound up, but without titles, and distinguished only by their numbers. We perceived there those of which the fathers Mabillon and Monfaucon have taken notice. The famous Muratori, in his vast collection of Italian historians, has published some, and made use of several others : The rest are unknown. They keep them secret, and do not even as much as show the catalogue of them to strangers ; which might make it suspected that this catalogue is imperfect. If the intention of the founder* had been followed, and but for a

* Cardinal Frederick Borromeo, archbishop of Milan, cousin to St. Charles and his successor.

century and a half ago sixteen persons of learning versed in the several kinds of literature, and a knowledge of the oriental languages, had applied themselves to decypher, explain, and publish these manuscripts, the republick of letters would long since have reaped the fruit of their labours ; but for want of sufficient funds, there are at present but three doctors maintained to look after this library, and thus the greatest part of the treasures contained in it remains buried in obscurity.

I saw in a cabinet of pictures annexed to the Ambrosian library, a numerous collection of designs for machines, executed and invented by Leonardo da Vinci, a cotemporary and rival of Michael Angelo. It is well known, that Leonardo being invited into France by Francis I. expired in the arms of that prince

prince, on receiving his visit. To the merit of a good painter, he joined also that of a good mathematician, for the age he lived in.

His master-piece in painting is a picture in fresco, representing our Lord's supper, with his twelve apostles, a little larger than the life. This piece is twenty feet long, by ten high. It is to be seen at Milan in the refectory of the Dominicans. It is surprising to find a picture now so fresh, which appeared so black and defaced to Misson, eighty years ago, that this traveller assures us, he was not able to make out any part of it. The present colouring, indeed, is not at all like that in the other works of Leonardo. It is not sufficient then to suppose, that within these twenty-five or thirty years past this picture has been cleaned by any
un-

unknown secret, as travellers say; but it must also have been painted over entirely anew. This I have been well assured of from very good authority. There is great appearance, therefore, that the beautiful disposition, the choice of attitudes, the distribution of the figures, in one word, that the composition is at present the only thing in this picture which belongs with certainty to its first author. It will not be deviating far from the object which I proposed to myself in this memoir, if I remark that not only the rules of perspective, which are too often neglected by the greatest painters, are regularly observed in this, but also those of opticks. We may judge of the truth of this assertion by the different position of the points of light which are variously reflected by the chrystal vessels according to their different form, or as their situation is

L more

more or less oblique with respect to the ray of light which strikes them.

I saw at Turin some experiments that were new to me, relative to the effects of gun-powder; and likewise two machines, which appeared to me very ingenious: the first was a wind-gun, which they loaded by setting fire, by means of a touch-hole, to two ounces of powder enclosed in a very thick cylinder of brass: this train, in communicating the fire through a very narrow channel, burns a thread which shuts up with a trigger the entrance of the chamber where the powder is put: the latter thereon takes fire without any explosion, and the air being dilated by this inflammation, preserves its spring for several months. They cause also a small portion of it to pass into a second chamber by opening a partition which shuts up
again

again immediately, and this little portion of the flame is sufficient to drive, on pulling down a trigger, a leaden ball sixty paces off. They can fire eighteen times successively in this manner, but each time with a diminution of its force.

The other machine is designed to measure the strength of the powder, which still keeps on burning in the closed cylinder of brass. The dilatation of the air produced by this inflammation, causes the water contained in the bottom of the same cylinder to ascend to a certain height in a glass tube fitted thereto. They then suffer the air to enter again by applying to the cylinder a treading pump; and we thus see how much of the inflamed spirit is necessary to condense the air contained in the cylinder, in order to make the water

L 2 ascend

ascend in the tube of graduated glass, to the same degree as the firing of the powder had raised it. The inventor of these machines is M. Mathi, pensionary of the king of Sardinia.

In the cabinet of natural history belonging to M. Donati, professor in the university of Turin, I saw several petrified trunks of trees, which had been dug up out of the mountains of Genoa. These leave us no room for suspicion as to the reality of their petrification.

I passed over Mount Cenis: on the 4th of July 1756, all the snows there were not dissolved; and on the 14th of the preceding month the waters of a little lake abounding in trout, situated on the height of a defile, through which the high road leads, were still frozen over.

As Mount Cenis passes for one of the highest mountains of Europe, I was desirous to make some experiments there on the barometer, and to compare the height which I should observe the mercury at in that place with those which I had remarked on the loftiest mountains of Peru. Accordingly I ascended the most elevated summit near the road to the right, about fifteen or sixteen hundred toises from the pond above-mentioned, and from the hospital of the Pelerins. I had already got as high as the village of Novalése, after three hours travelling on horseback, through a road which had been then newly repaired. I ascended again on foot for the space of near four hours more, and the last of them through a dry soil, interspersed with fragments of rocks, broken into leaves, and consisting of a species of Schiste-stone, or rough bastard

L 3 ardoise,

ardoise, which were only interrupted by masses of snow in such places as were most hollow. There wanted still twenty toises of perpendicular height before I could have attained the top of the mountain; when in crossing a hollow way covered with snow, and the sides of which were pretty steep, I perceived my foot fail under me. All I could do was to throw myself backwards on my breech: I slid in this position the length of twelve or fifteen toises, driving down the snow before me with hands and feet, in order to retard the rapidity of my fall: (I am entering here into a detail of what may not be unserviceable on a like occasion) I stopped where the bed of snow ended, and where the fragments of the rock began: I got off for a contusion on my foot and a few scratches. I regained then, not without difficulty, the foot of the rock, where the

the peasant had remained who served me as a guide, and I consoled myself for the accident that had befallen me, on finding my barometer in good condition. It was now near noon: I observed the height of the mercury to be nineteen inches ten lines and a half*, that is to say, a line and three quarters lower than at Quito in Spanish America, near the Equator, where by a great number of experiments we fixed the medium height of the mercury at twenty inches and $\frac{1}{4}$ of a line †, a height equi-

* This experiment was made with the portable barometer broke at Mount Vefuvius, and which I had got mended at Rome. I have compared it, since my return to Paris, with the best constructed and most accurately divided barometers, and have rectified my observations of the heights by them.

† See in the Historical Journal of a Voyage to the Equator, printed at the Louvre in 1751, the Latin inscription left at Quito, page 163.

L 4 valent

valent to 1460 toises above the level of the sea: whence I conclude that the place where I actually made this last experiment was not above thirty toises higher than the ground at Quito, the level of which surpasses by more than twenty toises the very utmost top of the Canigou *, the highest mountain of all the Pyrenees. It is true that I saw from the place where I fell some points of Mount Cenis, which were higher than those that I was then labouring upon; but the difference was not considerable, and amounted not to fifty toises, as far as I was able to judge of it.

* The Canigou is 1440 toises high, according to the geometrical mensuration of M. Cassini. The mercury rose there in 1740 to twenty inches two lines $\frac{1}{4}$. See Observations on Natural History, by M. le Monnier, physician, Meridian verified, page 224.

On my return to the hospital of the Pellerins, I observed there the height of the mercury in the same barometer, at three o'clock in the afternoon, to be 22 inches and half a line : that is to say, 26 lines more than at my station on the top of the mountain, which amounts to near 500 toises difference in the height of the two places.

Mount Cenis, therefore, must necessarily be the highest mountain of the Alps. Yet the White Mountain *, which we see from the banks of the lake of Geneva, at fourteen or fifteen leagues distance to the south-east, and the upper half of which is always covered with snow, is incomparably much higher. M. Fatio de Duillier, who measured its

* They give this mountain several names.

L 5. height:

height geometrically, makes it at the least 2000 toises above the surface of the lake; and the latter again 426 toises above the level of the sea, according to a calculation founded on the declivity of the Rhône, from its discharge out of the lake, by estimating this declivity at no more than double that of the Loire, measured by M. Picard: thus the total height of the White Mountain is, according to M. Fatio, 2426 toises above the sea, which amounts within a very little to the height of the craggy and eastern summit of the volcano of Pitchincha, where I myself saw the mercury descend in the barometer to sixteen inches*.

* The city of Quito, since in a great measure demolished by an earthquake, is situated at the foot of the volcano of Pitchincha, the highest summit of which exceeds the level of that city by about a thousand toises.

But M. de Chezeaux, who measured a much larger base than M. Fatio, and who ought therefore to have attained a precision as much greater in the heights which he had deduced from thence, increases still the altitude of the White Mountain 250 toises. Supposing then the height of the lake Lemman or Geneva above the level of the sea to be justly calculated by M. Fatio at 426 toises, the absolute height of the White Mountain will be 2676 toises; that is to say, upwards of 500 toises higher than the pike of Teneriffe, which has passed for the highest mountain of Europe*. The
White

* Father Feuillée, a Minim, in his manuscript voyage to the Canaries, makes the height of the mercury on the top of the pike of Mount Teneriffe about seventeen inches one line; this

White Mountain is also seen from the environs of Langresat sixty leagues distance,

compared with the heights of the mercury but little different from it, which we have observed on the mountains of the Cordilleras of Peru, whose height was geometrically determined, makes that of the pike 2150 toises, being a more exact measure than that resulting from the geometrical mensuration of the said father Feuillée, who concluded it to be 2213 toises, by a base too short and ill directed, and to the inclination of which also he paid no regard. For the rest, although the highest of mountains, as concluded upon by the barometer, are usually subject to great error, if we have not a correspondent observation made at the same time on the level of the sea, in the nearest place; yet this circumstance is not necessary in the neighbourhood of the Equinoctial line, where the variations of the barometer are very little: the greatest of them at Quito hardly exceeding one line. Thus in the neighbourhood of the Equator, the height of the mountains may be pretty

stance, from whence they distinguish its summit covered with snow above the chain of Mount Jura. This prodigious height, which exceeds by 1200 toises that of the Canigou, still comes not up to that of the highest mountains of the Cordilleras among the Andes of Peru; since of thirteen, the height of which I have calculated, seven are higher than the White Mountain, and Chimborazo in particular exceeds it by 550 toises, its height above the level of the sea, measured geometrically, being 3220 toises *. In short it is without controversy the highest mountain known, and probably the highest in the whole world: Its inaccessible part alone, from the foot

pretty often determined by the barometer alone, to within ten or twelve toises nearly.

* See Mensuration of the three first Degrees of the Meridian, page 56.

of

of the perennial snow where I encamped, to the top, is 800 toises perpendicular height *.

The melting of the snows in summer, being suspended every night in the gorges of the Alps, and renewed again every day during the hours in which the sun is hottest, gives occasion to very fantastical appearances. A valley in whose

* By very accurate experiments on the height of the barometer made at the same time at Geneva and Turin, as also at Turin and Genoa, on the sea shore, and which were communicated to me by M. I. A. de Luc, a citizen of Geneva, while this memoir was printing, it appears, that the height of the lake of Geneva, taken at the surface of the Rhône, at its issue out of the lake, is no more than 1124 feet, or not 18 toises above the level of the sea, instead of its being 426, which diminishes the height of the White Mountain 238 toises.

depth.

depth the eye is lost, covered with rough pieces of ice, resembling waves, and the whole surface of this sea again congealed, and intersected here and there with deep crevices, the noise of a subterranean torrent which supports this enormous mass, and changes the appearance as well as level of it from day to day; all these effects wrought by changes that are almost sudden, and variously combined of heat and cold, can scarce be seen any where else in so eminent a degree: they form together a very singular spectacle, worthy the curiosity of naturalists, and calculated to furnish new observations. Scheuchzer, in his *Iter Alpinum*, gives us a description of the ice-valleys of Swisserland, which is the name they bestow on those immense masses of ice; but it appears that the ice-valleys of Savoy are very different from them. The most celebrated

brated and most curious of these last is, at three days journey from Geneva, towards the sources of the Arve, at the foot of the White Mountain. The way to it is through the valley of Chamogny. I was on the point of quitting Geneva, when I was informed of these particulars: the tour demands at least eight days; it requires also preparations and conveniences with which I was unprovided, and cannot be undertaken by one person only. Some Englishmen performed it in 1741, but without any mathematical instrument. M. Jallabert showed me a short relation of their journey, printed without the name of the author, and calculated rather to excite than satisfy curiosity.

This is not a place for me to testify my acknowledgements for the favourable reception which I met with from
all

all the ministers of France in the several courts of Italy where I made any stay, and the marks of kindness with which I was honoured by many of the cardinals at Rome : but the obligations I owe to the count de Stainville, ambassador then from France to his Holiness, and the least of which was that I resided with him near a whole year ; permit me not to defer my publick acknowledgements for the same.

Measure.

Measure of several ancient Roman Monuments, taken with the greatest Accuracy.

Width of the gate of the Pantheon, taken between the marble casings of the jambs -
Diameter of the Pantheon at the surface of the ground, taken between the axes of two opposite columns, and being a medium between the diameters NE, SO, and NO, SE; which differ from each other two inches -
Length of the portico of the Pantheon between the axes of the two farthest columns -
Height of the column called Antoninus's pillar, from the upper part of the chapiter to the bottom of the plinth of the base -
Height of Trajan's pillar, taken from the same, but not comprehending the fillet -
Length of the shaft of a pillar of one single piece of granite, which was still lying on the ground near Monte Citorio, in 1756 -

Royal, or Paris feet.	Prefumed number of ancient Roman feet.	Concluded length of ancient Roman feet.
ft. in. lin.		lines.
18 5 4	20	131,8
137 2 0	150	131,6
98 9 9	110	129,3½
91 2 5	100	131,3
91 6 10	100	131,8½
45 6 2	50	131,8

[234]

Breadth

Breadth of the façade of the building in the baths of

Dioclesian, by M. Moreau, now member of the
academy of architecture, 126^t, 5^f, 6ⁱ, -

Side of the building of the said baths, by the same,
74^t, 0^f, 4ⁱ, 6ⁱ, -

Length of the inside of the great hall of the same
baths, which at present forms the church of the
charter-house, 30^t, 0^f, 10ⁱ, according to M. Mo-

reau; and according to Desgodets, 30^t, 0^f, 8ⁱ, 2ⁱ,

The longest interior dimension of the circumference
of Dioclesian's baths, taken on the side of the
theatre, 178^t, 1^f, 2ⁱ, -

The same in the baths of Caracalla, 198^t, 3^f, -

Medium length of the ancient Roman foot -

761 6 0	840	130,5
444 4 6	490	130,5
180 9 1	200	130,3
1069 0 2	{ 1175 1180	131,0 130,5
1191 0 0	1320	129,9
		130,9

If we allow 420 Roman feet diameter to the theatre of Marcellus, which Desgodets
has found to be 378 of our feet, the Roman foot will then contain 130,1 lines.

E R R A T U M.

Page 113, instead of *the gentlemen of
the faculty*, read *naturalists*.

B O O K S

Printed for G. KEARSLY.

BIOGRAPHIA BRITANNICA; or The lives of the most eminent persons who have flourished in Great Britain and Ireland, from the earliest ages, down to the present times: collected from the best authorities, both printed and manuscript, and digested in the manner of Mr. Bayle's Historical and Critical Dictionary. Six volumes, folio, 9l.

A complete collection of VOYAGES and TRAVELS. Consisting of above six hundred of the most authentic writers. Beginning with Hackluit, Purchass, &c. in English; Ramusio, Alamandini, Carreri, &c. in Italian; Thevenot, Renaudot, Labat, &c. in French: De Brye, Grynæus, Maffæus, &c. in Latin; Herrera, Oviedo, Coreal, &c. in Spanish: and the Voyages under the direction of the East-India company in Holland, in Dutch. Together with such other histories, voyages, travels, or discoveries, as are in general esteem; whether published in English, Latin, French, Italian, Spanish, Portugueze, High and Low Dutch, or in any other European language. Containing whatever has been observed worthy of notice in Europe, Asia, Africa, and America; in respect to the extent and situation of empires, kingdoms, provinces, &c. the climate, soil, and produce, whether animal, vegetable, or mineral, of each country; likewise the religion, manners,
and

BOOKS Printed for G. KEARSLEY.

and customs of the several inhabitants, their governments, arts and sciences, public buildings, mountains, rivers, harbours, &c. Illustrated by proper charts, maps, and cuts. To which is prefixed a copious introduction, comprehending the rise and progress of the art of navigation, and its successive improvements; together with the invention and use of the loadstone, and its variations. Originally published in two volumes in folio, by John Harris, D. D. and F. R. S. Now carefully revised, with large additions, and continued down to the present time; including particular accounts of the manufactures and commerce of each country. Two vol. folio, 4l. 10s.

An UNIVERSAL GEOGRAPHICAL DICTIONARY; or, Grand Gazetteer of general, special, ancient and modern geography: including a comprehensive view of the various countries of Europe, Asia, Africa, and America; more especially of the British dominions and settlements throughout the world: describing their soil, extent, and situation; their several productions, animal, vegetable, and mineral; their government, arts, manufactures, traffic, genius, manners, and religion; as well as the many admirable and stupendous curiosities (natural and artificial) to be found therein; with the most remarkable events, accidents and revolutions of past ages. Interspersed with many thousand uncommon passages, strange occurrences, and critical observations, both sacred and prophane: diligently extracted, and compiled with the utmost accuracy, from the most approved travellers, geographers, historians, philologers, &c. A work, not only agree-

BOOKS Printed for G. KEARSLEY.

agreeably amusing, but also instructive, and of singular utility to persons of every rank and station. Two vol. folio, 2l. 2s.

A new and complete edition of Mr. Tindal's translation and continuation of Mr. RAPIN's HISTORY of ENGLAND, brought down to the end of the reign of George II. Revised, corrected, and illustrated with 98 heads and monuments of the kings and queens, and 73 whole sheet maps, plans and charts, elegantly and accurately engraved. Twenty-one vol. 5 l. 5 s.

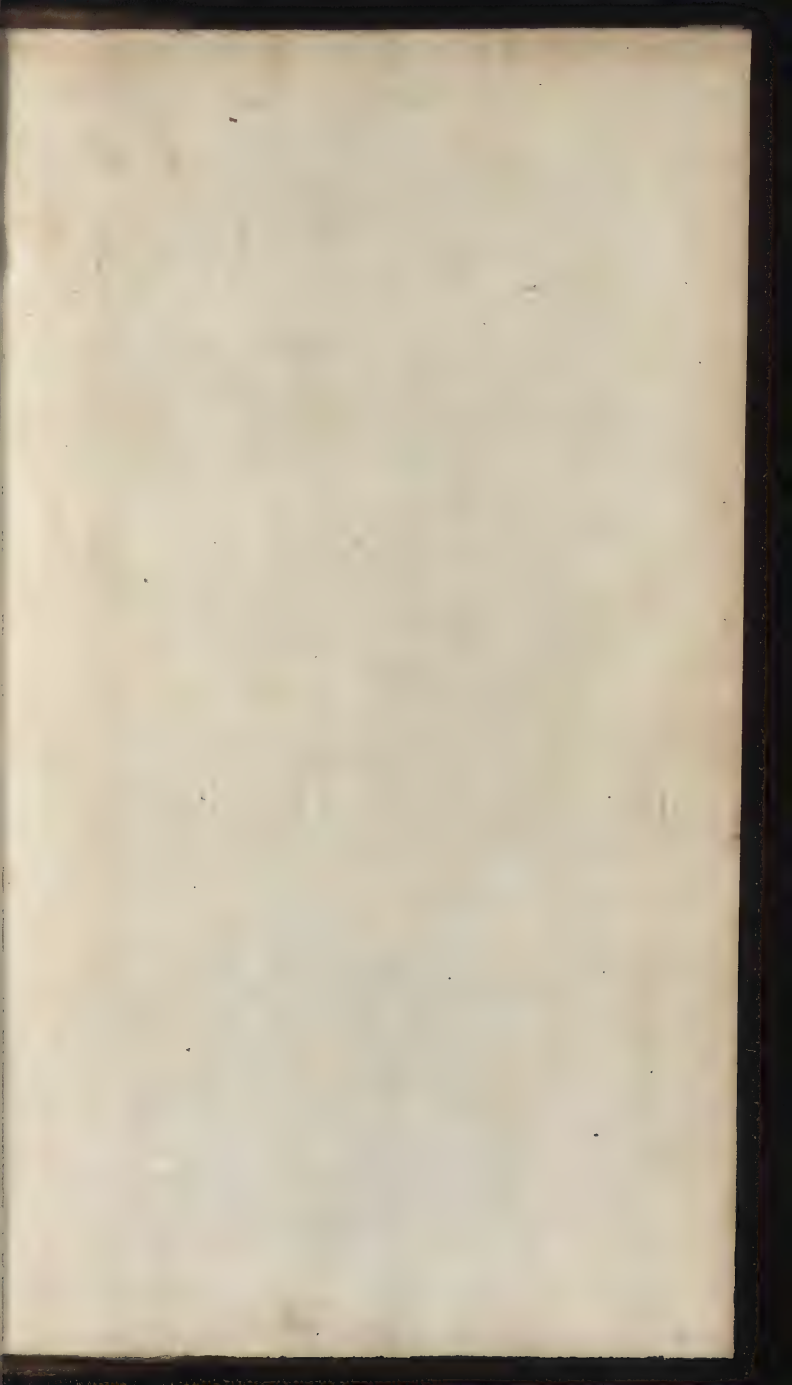
A TOUR thro' the whole ISLAND of GREAT BRITAIN. Divided into circuits or journeys. Containing. 1. A description of the principal cities and towns, their situation, government and commerce. 2. The customs, manners, exercises, diversions, and employment of the people. 3. The nature and virtue of the many medicinal springs with which both parts of the united kingdom abound, particularly those of Bath, Tunbridge, Bristol, Cheltenham, Moffat, &c. 4. An ample description of London, including Westminster and Southwark, their bridges, squares, hospitals, churches, palaces, markets, schools, libraries, shipping in the Thames, and trade by means of that noble river, &c. 5. The produce and improvement of the lands, the trade and manufactures. 6. The sea-ports and fortifications, the course of the river, and the inland navigation. 7. The public edifices, seats and palaces of the nobility and gentry. 8. The isles of Wight, Scilly, Portland, Jersey, Guernsey, and the other English and Scottish isles of most note. Interspersed with useful observations, and
an

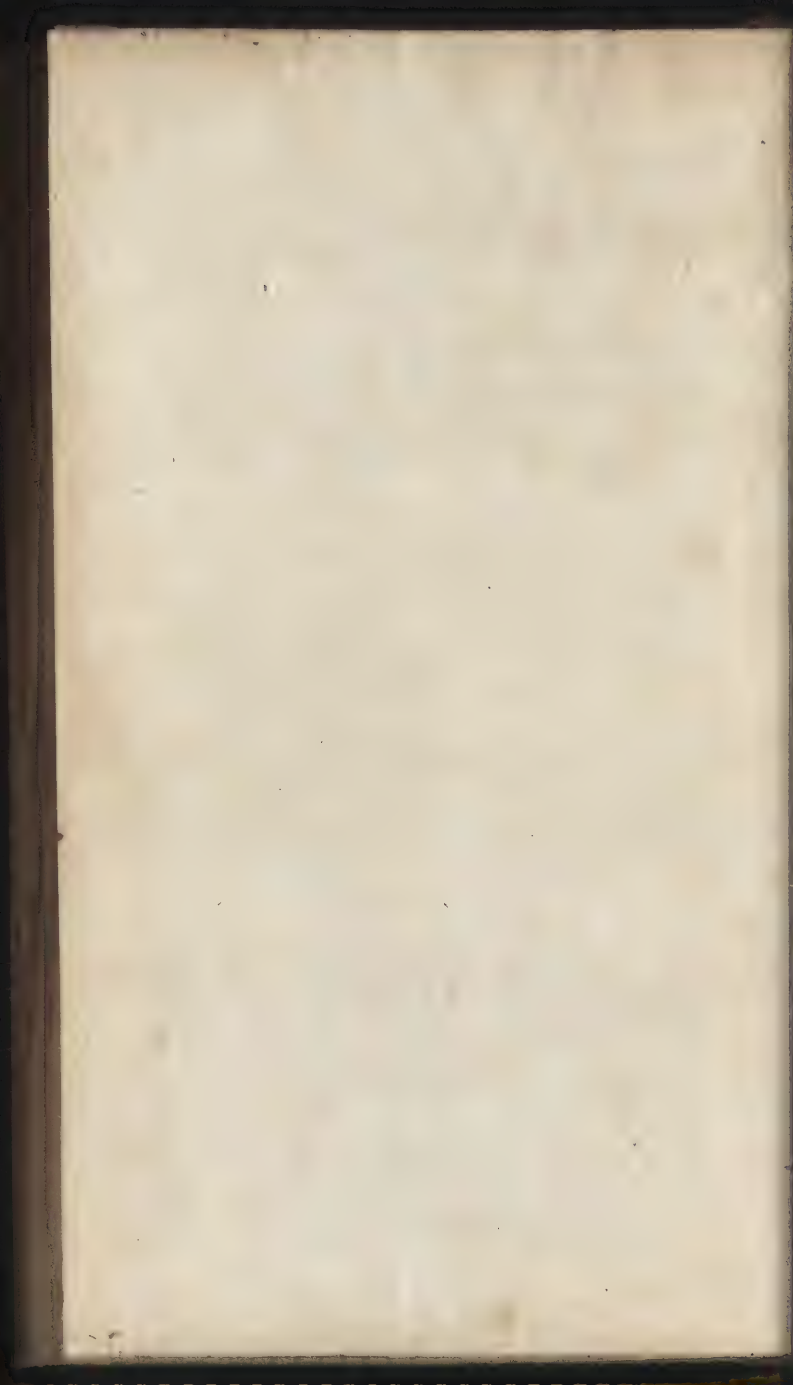
BOOKS Printed for G. KEARSLEY.

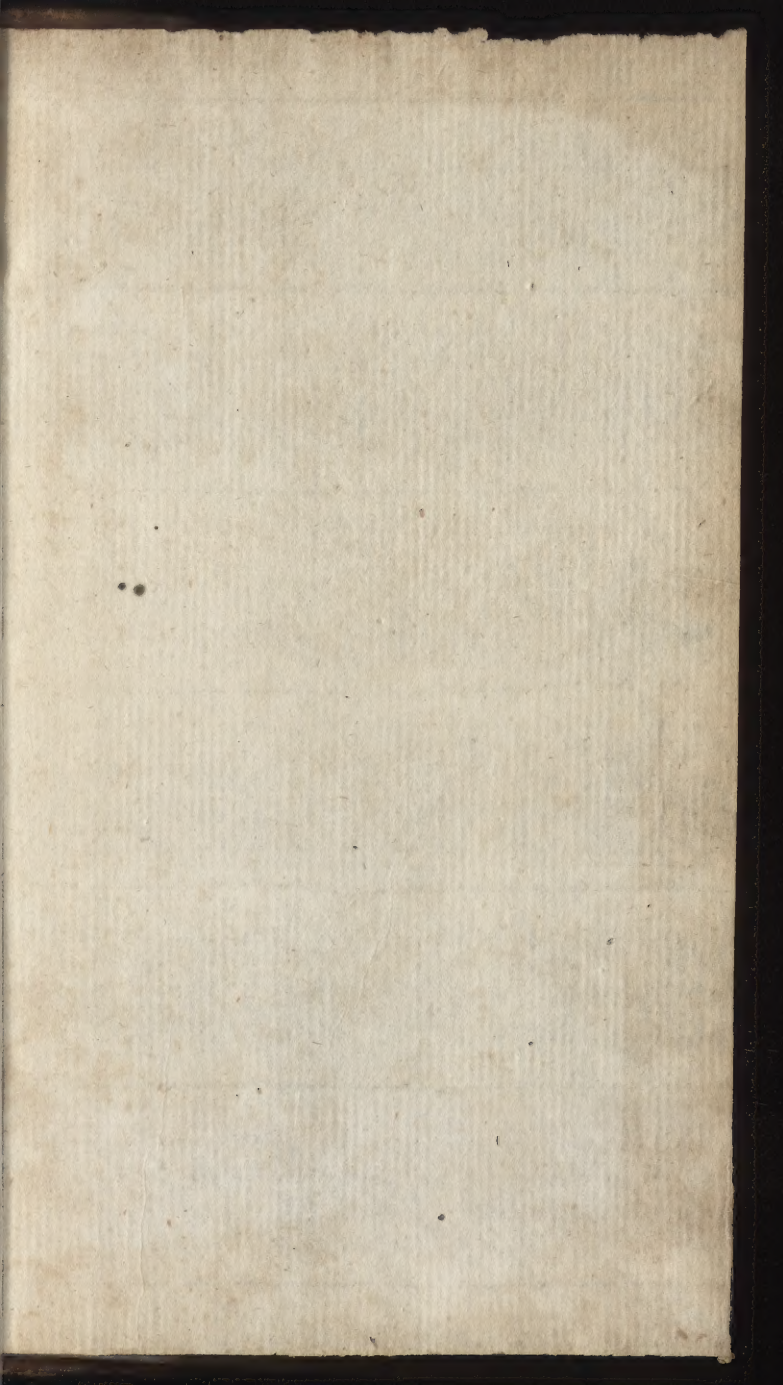
an index to each volume. By a gentleman. Particularly fitted for the perusal of such as desire to travel over the island. Four vol. 12 s.

The GENERAL GAZETTEER; or, Compendious geographical dictionary. Containing a description of all the empires, kingdoms, states, republicks, provinces, cities, chief towns, forts, fortresses, castles, citadels, seas, harbours, bays, rivers, lakes, mountains, capes, and promontories, in the known world: together with the government, policy, customs, manners, and religion of the inhabitants; the extent, bounds, and natural productions of each country; and the trade, manufactures, and curiosities of the cities and towns; their longitude, latitude, bearing, and distances, in English miles, from remarkable places; as also the sieges they have undergone, and the battles that have been fought near them, down to this present year. Including an authentic account of the counties, cities, and market-towns in England, and Wales, as also the villages, with fairs, the days on which they are kept according to the new stile, as well as the cattle, goods, and merchandize that are sold thereat. Illustrated with nine folio maps, viz. 1. A map of the world; 2. of Europe; 3. of Asia; 4. of Africa; 5. of North America; 6. of South America; 7. of England; 8. of Germany; 9. of France. By R. Brookes, M. D. 6 s.

A new and complete translation of the WORKS of VOLTAIRE. With notes historical and critical, embellished with cuts. By T. Smollet, M. D. R. Francklin, and others.







SPECIAL

85-B
91033

UNIVERSITY LIBRARY

